Navy Res. Dept.
Bibliography Sec.

SCIENCE

28 September 1956

Volume 124, Number 322

6 OCT 1 - 1956
Cont. Copy

Editorial Manpower and Education 565

Articles Scientists in the British Civil Service: *E. McCrensky* 567

Uptake and Turnover of Calcium-45 by the Guppy: *H. L. Rosenthal* 571

A. H. Hersh, Geneticist: *D. P. Quiring* and *F. DeMarinis* 575

News of Science Indians in the Peruvian Andes; How Many Chromosomes? International Cooperation in Uranium Exploration; National Seed Storage Laboratory; U.N. Exhibit to Commemorate Geneva Nuclear Conference; Archeology in Alabama; Organized Labor and the New Michigan Reactor; Borneo Zoological Expedition; TB in the United States; British Research Budget; Abortion in the U.S.S.R.; Radiation in Monkeys; News Briefs; Scientists in the News; Recent Deaths; Education; Grants, Fellowships, and Awards; In the Laboratories; Miscellaneous 576

Reports Subjective Evaluation and Reinforcing Effect of a Verbal Stimulus: *G. Mandler* and *W. K. Kaplan* 582

Influence of "Aging" on the Characteristics of an Electrodeless Discharge: *C. N. R. Rao* 583

Preparation of Pure Hydroxyapatite Crystals: *A. Perloff* and *A. S. Posner* 583

Beryllium-10 Produced by Cosmic Rays: *J. R. Arnold* 584

Quantum Yields of Fluorescence of Plant Pigments: *P. Latimer, T. T. Bannister, E. Rabinowitch* 585

Sperm Transport in the Reproductive Tract of the Female Rabbit: *G. S. Greenwald* 586

Cold-Adapted Genetic Variants of Polio Viruses: *G. R. Dubes* and *M. Chapin* 586

Influence of Crystalline Elastase on Experimental Atherosclerosis in the Chicken: *D. M. Tennent* et al. 588

Letters Scientific Method, Statistical Inference, and the Law: *G. W. McElrath* and *J. E. Bearman* 589

Of Books and Reading: *L. Wallerstein; G. Gallup* 590

Book Reviews *Reactor Shielding Design Manual; Floods; Methods of Biochemical Analysis; Studies of the Psychology and Behavior of Captive Animals in Zoos and Circuses; Précis de Géologie; The Negro Potential*; Books Reviewed in *The Scientific Monthly*; New Books 591

Meetings and Societies Election of AAAS Officers; Physiology of Reproduction; Meeting Notes; Society Elections; Forthcoming Events 594

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SARGENT-MALMSTADT

Automatic Titrator

Using Second Derivative Method of H. V. Malmstadt

1. **Greater operational time saving than any former so-called automatic equipment.**
2. **No electrode problems. Most titrations can be carried out with plain platinum or platinum-rhodium wire electrodes.**
3. **Correct end point is automatically derived by the circuit — no statistical or theoretical studies needed. No pre-setting of voltages. Push-button start, automatic shutoff.**
4. **Inherent accuracy is superior to voltage measurement or color indication.**
5. **Precision better than limits of normal techniques and reading.**
6. **Directly applicable to all types of redox, acid-base, precipitation and complexation titration systems.**
7. **Low cost, minimum maintenance.**

Developed and manufactured by E. H. Sargent & Co., based on the original work of H. V. Malmstadt, (Anal. Chem., 26, 1348[1954]).

S-29690 ELECTROMETRIC TITRATION APPARATUS—Automatic, Potentiometer, Sargent-Malmstadt (Patents pending).

For use in all titrations usually classified as potentiometric. Consisting fundamentally of a mixing and delivery unit with associated supports and an electronic control circuit.

The control unit contains the detecting, amplifying, differentiating and relaying circuits with a simple operational panel. At the rear of the control unit are a stirring motor switch for manual use, a fuse, connecting outlets to the valve unit, connecting outlet to the power supply, and a recorder outlet permitting, for research purposes, the recording of the second derivative curve with automatic cutoff.

The delivery unit contains a valve mechanism with an adjustable rate controller, an open ended motor driven chuck for the stirrer, stirring motor and electrode holders. The valve mechanism, mounted on a support with swinging beaker platform and a clamp for the titrating burette, is designed to accommodate any form of burette with or without stopcocks, so that it may apply to any type of titrating installation.

Dimensions of control unit: height, 7¾ inches; width, 10 inches; depth, 9 inches; power consumption, 100 watts; total shipping weight, 35 lbs.

Complete, including: control unit; stirring valve unit; support stand with beaker platform and burette clamp; one S-30490 calomel electrode; one each S-30440 electrode, platinum and platinum rhodium; one S-29695 delivery tip with internal platinum electrode, one S-76667 stirring rod; one S-76668 large stirring rod; connecting cable for recorder; and connecting cord and plug for standard outlets. Without beakers or burettes. For operation from 115 vol, 60 cycle A.C. circuits..... **$450.00**

SARGENT

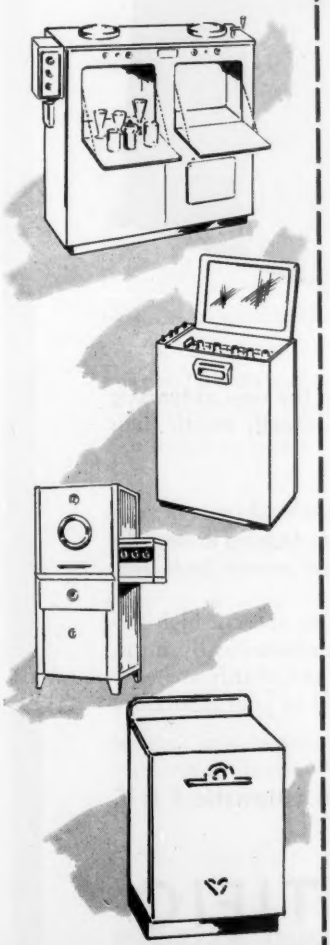
SCIENTIFIC LABORATORY INSTRUMENTS • APPARATUS • SUPPLIES • CHEMICALS

Catalog No. 100 Now Available

E. H. SARGENT & COMPANY, 4647 W. FOSTER AVE., CHICAGO 30, ILLINOIS
MICHIGAN DIVISION, 8560 WEST CHICAGO AVENUE, DETROIT 4, MICHIGAN
SOUTHWESTERN DIVISION, 5915 PEELER STREET, DALLAS 19, TEXAS
SOUTHEASTERN DIVISION, 3125 SEVENTH AVE., N., BIRMINGHAM 4, ALA.

if you wash laboratory glassware by machine...

Request
a generous free sample of ALCOJET, the finest machine detergent!



Your glassware washer is only as good as the detergent used. ALCOJET was developed *specifically* to wash laboratory glassware safely, thoroughly and spotlessly in any type of washing machine.

Foaming, in ALCOJET, has been reduced to a minimum and is so controlled as to assure maximum efficiency in all types of automatic laboratory washers as well as in special syringe and needle washers. ALCOJET is economical; only very small amounts are necessary for excellent results.

ALCONOX, Inc.
61-63 CORNELISON AVE., JERSEY CITY 4, N. J.

Ask your supplier for a sample or write.

Alcojet is available in;

Box 5 lb.	$ 3.00
Case (6 x 5 lb.)	15.00
Drum 25 Lb.	.45 Lb.
Drum 50 Lb.	.42 Lb.
Drum 100 Lb.	.40 Lb.
Drum 300 Lb.	.37 Lb.

(Slightly Higher west of the Rockies)

ALCONOX, INC., Jersey City 4, New Jersey

Please send without obligation a generous size free sample box of Alcojet.

Name of Company or Institution .....

Street Address .....

City ..... State .....

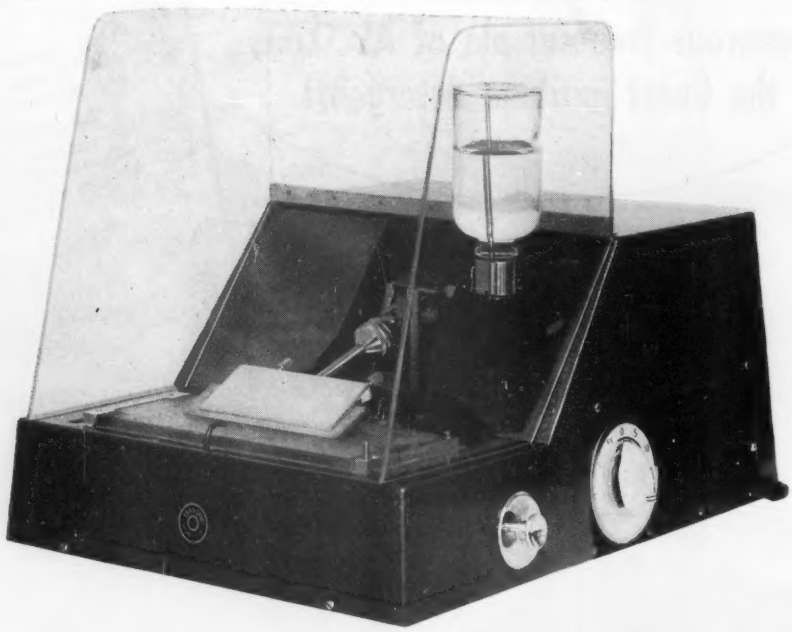
Requested By ..... Title .....

Type or Make of Washer .....

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of 3 March 1879. Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢.

DANGER!

DO NOT STROP



. . . that's right — when knives have been honed on the new automatic E & G Microtome Knife Sharpener — stropping will actually impair their super sharp edges!

This instrument, the world's finest microtome knife sharpener, was originally developed at the University of California at Los Angeles to meet the exacting requirements for ultra thin sectioning — but has proven itself even more efficient for routine sectioning.

The new E & G Microtome Knife Sharpener, with its special, high frequency vibration honing plate, and knife holder which automatically turns, accommodates knives up to 185 mm. in length. It is compact, sturdy and easy to clean, and is so automatic that it can be easily operated by your laboratory personnel.

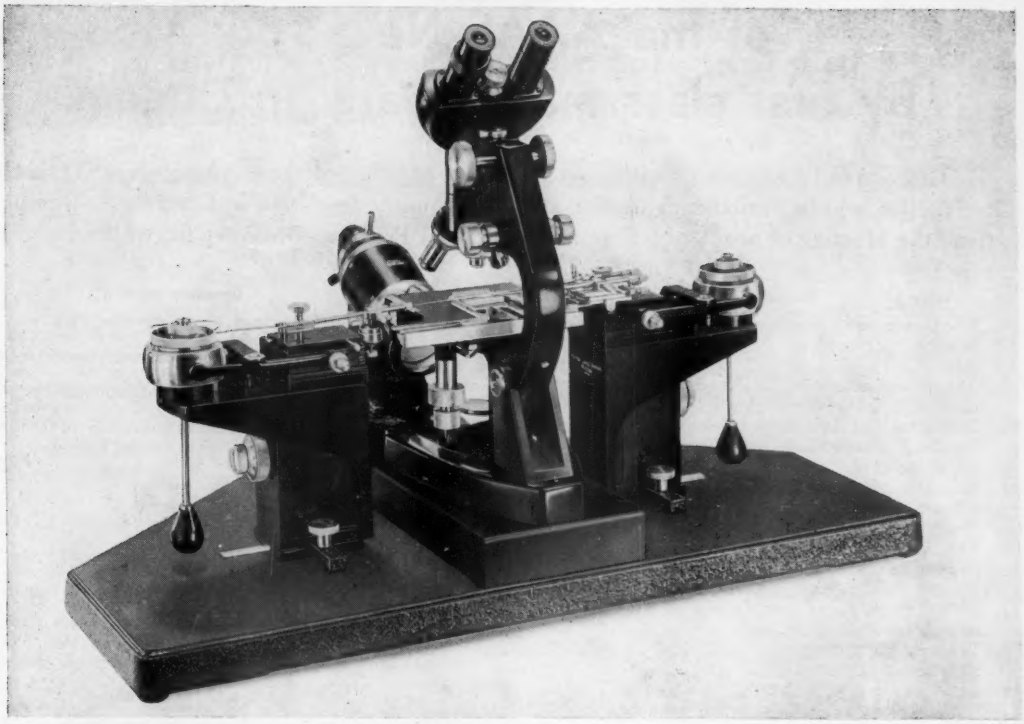
For further information on the unparalleled new automatic E & G Microtome Knife Sharpener, write to

ERB & GRAY SCIENTIFIC

854 S. FIGUEROA ST. LOS ANGELES 17, CALIF.

Leitz **first in precision optics**

THE NEW LEITZ MICRO MANIPULATOR



11656

Horizontal and vertical movements of this mechanically operated instrument are independent, but can be adjusted simultaneously. Adjustable ratio of movement enables micro knives, needles, pipettes, etc., to be kept within a field of 0.1 mm. Single and double needle holders are available. Positive control of micro-instruments, without backlash, drift, or thermal expansion assured.

A reputation for integrity and a tradition of service have led thousands of scientific workers to bring their optical problems to Leitz. If you have problems in this field, why not let us help you with them?

See your Leitz dealer and examine these Leitz instruments soon. Write for information.

E. LEITZ, INC., Dept. SC-9
468 Fourth Avenue, New York 16, N.Y.

Please send me the Leitz _____ brochure.

NAME _____

STREET _____

CITY _____ ZONE _____ STATE _____

E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N.Y.
Distributors of the world-famous products of
Ernst Leitz G. m. b. H., Wetzlar Germany – Ernst Leitz Canada Ltd.
LEICA CAMERAS • LENSES • MICROSCOPES • BINOCULARS

GET YOUR ADVANCE COPY

of the General Program-Directory of the AAAS New York Meeting by first class mail – early in December

The General Program-Directory of the 123rd Meeting of the AAAS in New York City, Dec. 26–31, 1956, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The two-session general symposium, "Moving Frontiers of Science," arranged by the Committee on AAAS Meetings.
2. The six sessions of the Conference on Scientific and Technical Editorial Problems.
3. Details of the anniversary celebrations of the AAAS-Gordon Research Conferences, Botanical Society of America, Freud *et al.*
4. Programs of the 18 AAAS sections (symposia and contributed papers).
5. Programs of the more than 80 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Manpower, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Hotel Statler—center of the Meeting—and other hotels and session sites.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1956 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1956.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the 1955 revised Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

Advance Registration

Advance registration has these decided advantages: 1)You avoid delay at the Registration Center upon arrival; 2)You receive the General Program-Directory in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; 3)Your name is posted in the Visible Directory as the Meeting opens.

The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program-Directory.

— THIS IS YOUR COUPON FOR AN ADVANCE COPY OF THE GENERAL PROGRAM-DIRECTORY —

1a. ☐ Enclosed is $3.00 for my advance Registration Fee which brings me the Program-Directory, Convention Badge, and all privileges of the Meeting.

1b. ☐ Enclosed is $2.00 for only the Program-Directory. (It is understood that, if I should attend the Meeting later, the Badge—which is necessary for all privileges of the Meeting—will be secured for $1.00 more.)
(Check one)

2. FULL NAME (Dr., Miss, etc.) .....
(Please print or typewrite) (Last) (First) (Initial)

3. ACADEMIC, PROFESSIONAL, OR BUSINESS CONNECTION .....

4. OFFICE OR HOME ADDRESS .....
(For receipt of Program-Directory)

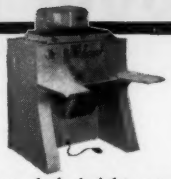
5. YOUR FIELD OF INTEREST .....

6. CONVENTION ADDRESS .....
(May be added later, after arrival)

Please mail this Coupon and your check or money order for $3.00 or $2.00 to the
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1515 Massachusetts Avenue, N.W., Washington 5, D.C.

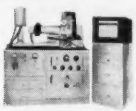
HANDICAPPED by faulty lab instrumentation?

turn to JAco for instruments that will make your job easier



JAco Console Comparator Microphotometer

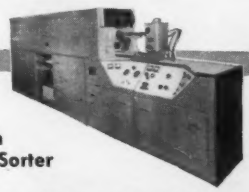
New desk height console style with controls arranged for left hand use to free writing hand. Manual coarse motion control and motor driven fine motion with speed approximately 5 microns per sec. Bright image — may be viewed in normally lighted room. Scanning period and distance controlled by foot switch or push button.



Hilger Raman Spectrograph

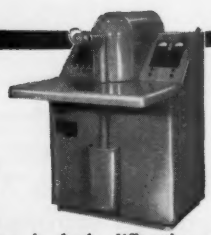
Source features mercury lamps inside diffuse reflector — four times more efficient than reflecting mirrors. Specimen cells easy to change. Available with interchangeable F/1.5 or F/5.7 cameras for alternate use as recording and photographic instrument. Large aperture — ideal for any application demanding ultimate photographic speed.

Why let outmoded instruments — or even lack of proper instruments — stymie your research or production control procedures? Discover how JAco designed-for-the-job equipment can help you do your job more efficiently and at less cost. Write for specific catalogs or describe your procedures and we'll send information on *all* applicable JAco Instruments.



JAco Ebert Spectrograph with Order Sorter

The widely acclaimed JAco Ebert Spectrograph is now available with a new Order Sorter that presents several orders simultaneously at high dispersion, each as an individual spectrum. Dispersion up to 0.18 A/mm, resolution 300,000. Low scattered light, flexible in application, easy to interpret determinations.



Hilger Micro-Focus X-Ray Unit

Wide application in both diffraction and micro-radiography. Features low exposure time, high resolution, and provision for utilization of special techniques. Focal spot diameter is of the order of 0.04mm. Wide range of interchangeable targets. Safety interlock switches eliminate possibility of misuse.

JAco Atomcounter Direct Reading Spectrometer

30,000 line/inch grating gives 5.3 A/mm and excellent intensity over range from 2200 A to 5600 A. Utilizes new patented optical system and electronic circuitry. Performs analysis in 1 minute or less with deviation of only 1-2%. Unitized construction.

SALES OFFICES:

DETROIT 13680 Capitol Ave.
EL CERRITO, CAL. 1344 Devonshire Dr.
PITTSBURGH, PA. 916 Greenhill Rd.
LOS ANGELES (DUARTE) Miltonwood Rd.

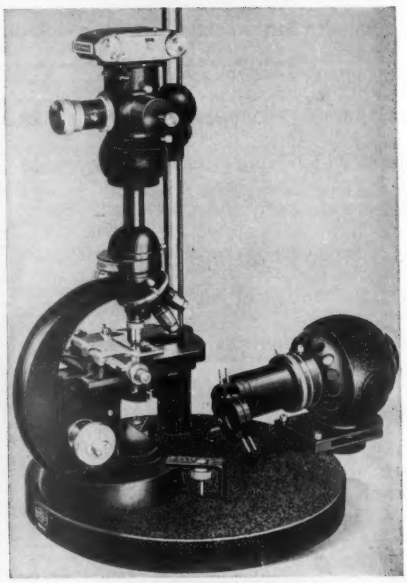
JARRELL-ASH COMPANY
26 Farwell St., Newtonville, Mass.

Write for information on these other JAco Instruments:

Refractometers *Polarimeters* *Photoprocessors* *Blood Arithmometer*

MADE IN CARL ZEISS WEST GERMANY

FLUORESCENCE MICROSCOPY



FLUORESCENCE MICROSCOPY is becoming increasingly important in fundamental research, histology and physiology, as well as clinical and diagnostic routine examinations in haematology, bacteriology and parasitology.

THE CARL ZEISS LARGE FLUORESCENCE EQUIPMENT was especially designed to completely fulfill the requirements of modern fluorescence microscopy. Ultraviolet or blue-violet excitation is established by means of special filter combinations, permitting fluorescence observation over the entire range of the visible spectrum. Transparent as well as opaque specimens can be examined with this equipment.

A high-pressure mercury vapor burner produces such intense luminosity that the equipment is not only suitable for observation but also photomicrography. For this type of work we recommend the well-known Attachment Camera with beam-splitting prism for fluorescent light and camera body for 35mm color or black-and-white films.

Write for free detailed literature

CARL ZEISS, INC., 485 Fifth Avenue, New York 17, N. Y.

Guaranteed uninterrupted repair service

28 September 1956, Volume 124, Number 3222

SCIENCE

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

PAUL B. SEARS, *President*
LAURENCE H. SNYDER, *President Elect*
GEORGE W. BEADLE, *Retiring President*
WALLACE R. BRODE
PAUL M. GROSS
GEORGE R. HARRISON
MARK H. INGRAHAM
PAUL E. KLOPSTEG
CHAUNCEY D. LEAKE
MARGARET MEAD
THOMAS PARK
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Executive Officer*

DAEL WOLFLE, *Executive Officer*
GRAHAM DUSHANE, *Editor*
CHARLOTTE V. MEETING, *Assistant Editor*

Editorial Board

MARK H. ADAMS — KARL LARK-HOROVITZ
WALLACE R. BRODE — EDWIN M. LERNER
BENTLEY GLASS — WILLIAM L. STRAUS, JR.

Editorial Staff

SARAH S. DEES, OLIVER W. HEATWOLE, YUKIE KOZAI, JEAN MCCARTHY, ELIZABETH MCGOVERN, ELLEN E. MURPHY, ROBERT V. ORMES, BETHSABE PEDERSEN, MADELINE SCHNEIDER, JOSEPH TURNER, JACQUELYN VOLLMER, LENORE I. YODER

EARL J. SCHERAGO, *Advertising Representative*

SCIENCE founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature* and in the *Industrial Arts Index*.

Editorial and personnel-placement correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts, book reviews, and illustrations, see *Science* 123, 714 (27 Apr. 1956).

Display-advertising correspondence should be addressed to SCIENCE, Room 604, 11 West 42 St., New York 36, N.Y.

Change of address: The notification should reach us 4 weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

Manpower and Education

The shortage of educated manpower has been a matter of increasing concern to industrialists, educators, scientists, and government officials. This concern will undoubtedly continue, for our more and more elaborate technology demands that an increasing proportion of the people should become educated to their maximum capacity.

Recently the Subcommittee on Research and Development of the Joint Committee on Atomic Energy held hearings on the shortage of scientific and engineering manpower and has since reported some of its findings and recommendations. The subcommittee wisely recognized that the shortage of scientists and engineers is only a part of the problem and that an over-all increase in the number of trained people in all fields would be in the national interest. A recurrent theme in the hearings and one that is emphasized in the report is that the quality and quantity of instruction in mathematics in our high schools is of such fundamental and general importance that vigorous action should be taken to improve mathematics teaching and to strengthen the place of mathematics in the curriculum [see *Science* **123**, 965 (1 June 1956)].

The subcommittee proposed that a remedial program should have the following requirements: early identification of able students and the provision of courses that would engage their interest and stimulate their minds; encouragement of able students to continue education beyond high school; removal of economic barriers to education; improvement of the supply of high-school and college teachers; better use of available talent in industry, defense, and education; improvement of in-service training in industry.

Numerous recommendations were made on how these requirements might be met. Among them were better pay for high-school teachers; an educational reserve made up in part of properly qualified men and women from industry who would be released at full pay for high-school teaching and in part by people recruited from the ranks of the retired; and federal support for scholarship programs.

These are clearly preliminary recommendations. At this stage of the consideration little effort has been made to criticize them, to appraise their possible effectiveness, and to fit them into a suitable pattern. Nor have the hearings brought out as yet any careful appraisal of the educational role of the Federal Government in relation to that of state and local governments.

Nevertheless, it is good that the hearings have been held and the recommendations put forward, for these activities mark the first steps in the fact-finding procedure that Congress normally uses as a basis for legislation.
—G. DUS.

NOW E-X-T-E-N-D-E-D Range!

NEW TESTS, NEW APPLICATIONS

Simple, inexpensive tests, helpful in diagnosis of coronary artery disease, can now be made with Bausch & Lomb Spectronic 20 Colorimeters. Special adaptation, extending instrument range to 340mμ in the U-V, makes assay of serum glutamic-oxalacetic *transaminase* a routine clinical procedure. (Detailed clinical method available on request.)

Many other new tests, including vitamin assays, are made possible by pinpoint selection of any wavelength in the 340mμ-950mμ range.

BAUSCH & LOMB Spectronic 20 COLORIMETER

SAME EASE, SPEED AND DEPENDABLE ACCURACY

Easy As Tuning Your Radio! Dial instantly sets Certified-Precision diffraction grating to desired wavelength; no color filters to fuss with.

Fastest Readings! Simply insert sample tube; instant-acting meter gives exact percent transmission, or optical density.

Accurate Analyses! Narrow band pass (only 20mμ) assures highest spectral purity. 49 clinical calibrations available.

LOW PRICE, DOUBLE VALUE

Colorimeter *plus* spectrophotometer, 375mμ-950mμ (extended range to 340mμ at slight extra cost), for less than the price of most colorimeters alone!

BAUSCH & LOMB OPTICAL CO.
64209 ST. PAUL ST., ROCHESTER 2, N. Y.

- ☐ Send me 11-page reprint of "Clinical Method for Assay of Serum Glutamic-Oxalacetic Transaminase" plus references and charts.
- ☐ Send me B&L Spectronic 20 Catalog D-266.
- ☐ I would like an obligation-free demonstration of the B&L Spectronic 20 Colorimeter at my convenience.

NAME .....

TITLE .....

ADDRESS .....

CITY ..... ZONE ..... STATE.....

MAIL COUPON TODAY FOR VALUABLE DATA

BAUSCH & LOMB
SINCE B&L 1853

America's only complete optical source.. from glass to finished product.

28 September 1956, Volume 124, Number 3222 SCIENCE

Scientists in the British Civil Service

Edward McCrensky

The current personnel policies and methods used in the British civil service for scientists are relatively recent in their development. Until World War I, relatively little scientific work was done by British government departments. The outbreak of World War I exposed the dependency of Great Britain on Central Europe for many products demanding high scientific skills and showed the need for more scientists in the government service. In 1916 the Department of Scientific and Industrial Research was set up to carry out research in its own laboratories, to stimulate the supply of scientists, and to encourage industry to undertake more research. Small numbers of scientists were also employed before World War I, and many more after, in the British Defence Departments.

Background

World War II gave a vigorous impetus to the development of government scientific work, resulting in a great increase in the numbers of scientists employed and also in the use of scientists as chief advisers to the government. The nation's scientific manpower was mobilized to help win the war, and large numbers of scientists and engineers came into government employment from universities and industry. Science became recognized as an important and continuing sphere of government programs. Key political and government leaders realized, also, from their wartime experience in recruitment, utilization, and general management of scientists, that a new charter was necessary for creation of a unified scientific service that would strengthen the attractiveness of a career in the postwar government service to high-caliber men and women.

The Treasury established in 1943 a small committee popularly known as the Barlow committee after its chairman, Alan Barlow, second secretary to the Treasury. Barlow, Edward Appleton, secretary of the Department of Scientific and Industrial Research (this is the premier scientific position in the British civil service), and a scientist representative from industry and one from Cambridge University composed the committee. The committee's recommendations for a stronger scientific civil service were divided into three main categories: condition of service, pay, and organization (*1*). Most of the recommendations were accepted by the government, which in some cases carried the proposals even further than the committee recommended.

The new organization reflecting these ideas was made effective in 1945. The main features of the resulting scientific civil service were as follows.

1) Better conditions of service were introduced to facilitate and stimulate research.

2) The status and salaries of scientists in the civil service were improved.

3) Three separate but interdependent classes were established to make up the scientific civil service: (i) the scientific officer class, (ii) the experimental officer class, and (iii) the assistant (scientific) class.

4) An interdepartmental scientific panel was established and charged with constant review of the efficiency of the scientific civil service and with the proposal of changes in organization or policies to promote the well-being of the scientific civil service.

5) Centralization of all recruitment for permanent posts in the scientific civil service was placed in the Civil Service Commission. A new commissioner was added to the Civil Service Commission to oversee this responsibility. This "scientist" commissioner has responsibility for directing the recruitment programs for the scientific civil service.

It should be noted that in the British civil service the term *scientific civil service* designates only those scientists and engineers who are engaged in research, development, and design activities. Engineers engaged in production, maintenance, surveying, and in such fields as civil, architectural, structural, and sanitary engineering are found in a separate classification known as the "works group of professional classes." The supporting subprofessional classes are in "technical grades." This article does not touch on these employees but describes only the scientific civil service.

Approach to Personnel Administration

The British civil service approach in personnel administration has several major features relating to scientists and engineers engaged in research and development. Some of these are closely related to the national culture and should be thus evaluated. A fundamental precept is that there are no political appointments in the British civil service. Provided that his qualifications are satisfactory, a man can rise to the most senior position. This nonpolitical character of the entire civil service is reflected in the severe restrictions upon British civil servants' engaging in political activities or making public utterances of an official nature. Differences of opinion that may be felt by a government science administrator will never be resolved in public statements. Other aspects, however, spring from British evaluation of their experience in recruitment, development, and retention of scientific personnel, and these aspects reflect a conscious desire to improve the vitality of the scientific civil service.

An example of the British national scientific personnel policy is the recognition of the special needs of scientific person-

The author is director of the Civilian Personnel and Services Division of the Office of Naval Research.

nel that is shown by the establishment of high-level scientific representation on the Civil Service Commission Selection Board, which is responsible for filling all permanent positions in the scientific civil service. The scientist commissioner, holding a post established in 1945, and the scientific section that reports to him devote their time exclusively to finding and selecting scientists and engineers for permanent appointment to the scientific civil service. The present commissioner and scientific adviser, C. P. Snow, formerly of Cambridge University, is recognized as a scientist.

This high-level emphasis on sympathetic understanding and administration of recruitment, examining, and selection programs fosters development of a close and harmonious working relationship between the scientific commissioner and the chief scientists in the departments that employ scientific, engineering, and supporting personnel. The interviewing panels that determine the suitability of all candidates are made up of senior scientists from the employing departments under the chairmanship of the commissioner or a scientist whom he may appoint to represent him. Therefore, the selection of scientific personnel is made within a vertical framework of commission and department cooperation with a scientist civil service commissioner as its policy head.

Organization

As already mentioned, the term *scientific civil service,* as used in the British civil service, includes scientists, engineers, experimental officers, and scientific assistants.

The scientific civil service has three principal breakdowns or classes. The first, the scientific officer class, which is the senior class within the scientific civil service, is recruited principally from first- and second-class university honors graduates. This class is the creative, initiating, and directing element of the British scientific civil service. It forms the spearhead of the scientific attack and is supported and aided by the other classes. Next is the experimental officer class, which is the main support of the scientific officer class; it is recruited both from university graduates and from men and women with technical training who have not completed university work. Experimental officers work under the general guidance of scientific officers, undertaking scientific responsibility frequently without detailed supervision. A member of the experimental officer class is normally one of a team working under the general guidance of a member of the scientific officer class. About 25 percent of the experimental officers have degrees. Those with significant achievement and promise of creative ability may be selected by a promotion panel of scientists for entry into the scientific officer class, but the standards are high and only a small number of such promotions occur.

The third class in the scientific civil service is the assistant (scientific) class. Its duties are to provide general assistance to the scientific officer and experimental officer classes: care and preparation of apparatus, observation of experiments and tests, and related tasks. The assistant (scientific) class would correspond generally to the categories of laboratory mechanic and technician in the United States civil service. Its members are principally recruited from persons who have an equivalent of a high-school education and who have had some training in mathematics or science.

In general, all these classes have fixed maximum age limits for recruitment to established posts. The upper age limit for appointment to the senior scientific officer grade is 31; for the scientific officer and assistant experimental officer grades, age 28; and for the experimental officer grade, age 30. For the last-mentioned grade, the upper age limit is at present waived for candidates who have had particularly useful experience.

Special facilities exist that permit regular ex-service officers and men to deduct their length of service from their age to enable them to have a "notional" age within the normal competition age limits. In this way, ex-service personnel can be recruited, and advantage is taken of this privilege especially in the experimental officer and assistant (scientific) classes.

The major employing agencies of scientific personnel, such as the Admiralty, the Ministry of Supply, and the Department of Scientific and Industrial Research, have scientific sections responsible for the internal personnel management of the scientific civil service. These sections reflect an organizational responsiveness to the special needs of scientists within the organization.

In the Admiralty, the scientific organization is known as the Royal Naval Scientific Service. The chief of Royal Naval Scientific Service is H. F. Willis, an eminent scientist and former head of one of the principal Admiralty laboratories. The superintendent of scientific personnel, who is a member of the scientific civil service, is the personnel officer for the Royal Naval Scientific Service, the staff of which is employed in the headquarters organization and in the laboratories. All proposals to the Board of Admiralty involving appointment, promotion, reassignment, transfer, and training are made by the chief of the Royal Naval Scientific Service or are delegated to the superintendent of scientific personnel. The personnel-processing, security, and other administrative functions, including the formal authorization of appointments, promotions, and dismissals, are executed by the establishment officer of the Admiralty. He is not in the Royal Naval Scientific Service, but he is responsible for the over-all administrative and personnel operation of the Admiralty.

This same pattern of organization exists in the Ministry of Supply, which is the largest employer within the British Government of scientific and engineering personnel. The chief scientist, Owen Wansbrough-Jones, is a top official of the Ministry of Supply. The director of technical personnel administration in the Ministry of Supply is responsible to the chief scientist and performs essentially the same functions as those described for the superintendent of scientific personnel in the Royal Naval Scientific Service. However, the Ministry of Supply does not use any special designation for its scientific corps.

Each major government department that employs a considerable number of different classes of scientific staff has its own scientific personnel section with responsibility for personnel management in the scientific service of that department.

An impression of the British scientific civil service widely held in this country is that all its members are in permanent positions with tenure and full civil-service perquisites. Actually, a large percentage of the employees in the scientific civil service, averaging in some departments as much as 30 percent of the total, hold temporary appointments without any tenure and are not under the civil-service retirement system. Temporary personnel may be appointed on sole authority of the departments, but in the event of reduction in force, they provide a cushion for absorbing the cut.

In 1955 there were 14,724 temporary and permanent employees in the scientific civil service. The scientific officer class had 3416, the experimental officer class 6030, and the assistant (scientific) class 5278 (*2*).

Role of the Treasury

Any discussion of British personnel policy must start with the role of the Treasury. There is no counterpart among U.S. departments and agencies to the British Treasury. It is the senior government department responsible for over-all personnel policies, staffing ceiling, and finance. Its functions are allied to those performed by the Bureau of the Budget, the Civil Service Commission, and the General Accounting Office in the U.S. Government. Through the Treasury's control of staffing for each department, it exercises a direct effect on the number of higher level positions to be established in any year and on the degree of promotion

expectancy and the rate of promotion. In its role as financial agent for the government, it determines the future of appropriations for current programs, expansion plans, and new research facilities.

Recruitment and Selection

The Treasury assigns to each agency a complement of "established" positions based on its needs for maintaining a firm stability for the permanent staff. The ratio of temporary to permanent appointments is therefore flexible.

Scientific and supporting personnel interested in employment in British civil service may apply for either of two kinds of appointments: (i) the "unestablished" or temporary appointment without tenure, which is made by the agency or department independent of age limits but is subject to the rules and regulations issued by the Treasury, or (ii) for "established" or permanent appointments obtainable only through open civil-service competition and conferring full civil-service privileges.

The government departments advertise constantly for all grades and kinds of scientific staff in the principal newspapers and appropriate journals. Applicants who respond are considered for temporary appointments. The Civil Service Commission also advertises its open continuous competitions in the principal newspapers and appropriate journals. Paid advertising has been considered an essential and continuing requirement during recent years.

As already indicated, special action may be taken if necessary to fill highly specialized or other posts for which suitable candidates are not available from existing staff. Posts at the intermediate level would be advertised (at appropriate grade and salary) by the Civil Service Commission in the usual way, with any necessary relaxation of normal age rules, and the process of selection would be as already described. In the case of the very highest posts, however, public advertisement is not favored. Instead, all government and other scientists of the required standing are considered by high-level scientists and administrators, working in conjunction with the Civil Service Commission, and the most suitable individual available would be invited to accept the appointment.

The selection of candidates for permanent appointment to the scientific civil service is based essentially on a critical evaluation of school or university records, work accomplishments, and potential for development. The procedure for selecting candidates for appointments in the scientific civil service has already been described. It is similar to that followed by the Boards of Examiners in the U.S. civil service. However, a major difference is that the British require a personal interview with each candidate. Candidates are invited for interviews only after the satisfactory conclusion of a basic review of their records and of the corroborative information obtained from references and other sources. Candidates who are invited to report for an interview receive their transportation expenses from the government.

Because selection for permanent positions is centralized in the Civil Service Commission, candidates need not apply for employment in particular departments. Assignment of successful applicants is made by the commission, with advice of agency panel representatives, to individual departments. All appointees must agree to accept transfer anywhere in the scientific service of the department (*3*).

Classification

Employees in the scientific civil service who are recommended for advancement at the periodical promotion reviews (which cover grades up to and including principal scientific officer and senior experimental officer) are considered by panels of their seniors. Promotion is usually to the next higher grade in the class but, as already mentioned, "class-to-class" promotions are also possible. By means of annual confidential reports, a regular and systematic appraisal is made of actual performance and potential of all classes of staff. The duties and responsibilities of the scientific staff do not affect promotion up to the level of principal scientific officer. The level of performance achieved and the promise that is demonstrated are the major criteria for promotion.

The scientific officer class has six grades: scientific officer, senior scientific officer, principal scientific officer, senior principal scientific officer, deputy chief scientific officer, and chief scientific officer. Entry of new appointees is normally to the scientific officer or the senior scientific officer grades. Promotion which is a change in grade is made only through movement to the next higher grade, such as from scientific officer to senior scientific officer. These promotions are initiated after decision by the reviewing panel of scientists. No change in duties and responsibilities is necessarily required, either before or after a promotion to the principal scientific officer or the senior experimental officer level. Normally positions at the senior principal scientific officer level and above carry a substantial measure of administrative responsibility. It is recognized, however, that there are scientists of marked creative ability whose advancement should not involve any break in their scientific work; in such cases, subject to the recommendation of a high-level selection board, the Treasury may approve promotion on "individual merit."

Although in theory no change in duties and responsibilities is necessary for a promotion, in fact, greater work responsibility usually accompanies the action. However, duties are described in broad terms such as "head of a branch conducting research in electronics" rather than in any detailed fashion. Classification, therefore, in the sense the word is taken in the U.S. civil service, that of placing a person in a particular grade after an objective evaluation of duties and responsibilities without major consideration of how these duties and responsibilities are being performed, does not exist for scientists in the British civil service. Instead, selection for promotion is made in recognition of employee accomplishment, personal development, and future potential; it does not give any major weight to difficulty-of-job factors in the scientist's current work assignment.

Generally, the career expectancy of the new appointee fresh from the university to a scientific officer position is to reach the principal scientific officer grade during his career; about one in six can be expected to proceed further. Promotion to this grade is achieved by demonstration of scientific ability and generally also requires administrative abilities as well.

There are, as already mentioned, a few posts in the senior principal scientific officer grade which are specifically set aside for scientists engaged on individual research and which carry no administrative responsibilities. Because the complement of the scientific civil service in each department is assigned by the Treasury in terms of a specific number of posts in each grade, vacancies in such grades or assignment by Treasury of additional positions at the higher grades must occur before promotions may be made. All posts of senior principal scientific officer and above are, in fact, individually approved by the Treasury, and no substantial alteration in their duties and responsibilities may be made without specific Treasury authority. Table 1 shows the distribution of personnel in the British scientific civil service by classes, grades, and salary ranges on 1 July 1955.

Professional Development

Training within the scientific civil service reflects a dependence on career development of personnel for future scientific leadership and accomplishment. Except for top laboratory or chief scientist positions, for which the whole scientific civil service may be combed to obtain the best individual available, or in the case of the need of a highly specialized scientist not found within the roster of the service, the higher positions are normally

filled by promotion from within. The need for continuing development of young scientists who are brought in at a young age in the scientific officer class creates a sensitivity among supervisory scientists toward their personal responsibility for providing both climate and policies that will lead to the maximum professional growth of the reporting staff.

Such techniques are used as attachment of junior scientists to those with greater experience; the rotation of assignment of scientists among the laboratories and headquarters staff, including occasional interchange with scientists in other parts of the British Commonwealth; the appraisal of each employee of the scientific service through annual confidential reports, both to determine his progress and to help to decide on promotion; the assignment of staff to universities or private laboratories for special training, and the participation of staff in employee development conferences. In addition, fellowships and attendance at staff colleges are also possible.

Role of the Staff Association

Employee-management negotiating machinery is very highly developed in the British civil service. There are negotiations between departments and recognized staff associations; negotiations through the national and departmental Whitley Councils composed of representatives of the government and of staff associations; and the existence of an arbitration tribunal in the Ministry of Labour.

Civil servants are encouraged to join the staff association that represents their particular occupational class (*4*). The large majority of the scientific civil service, including personnel in the highest ranks, are members of the Institution of Professional Civil Servants, which is one of the larger staff associations. The Institution of Professional Civil Servants has the right to consultation with management of a department or of the Treasury on proposals affecting their members. It also has the right to request arbitration on cases where no satisfactory agreement may be negotiated with the department concerned through the arbitration tribunal established in the Ministry of Labour. A member of the scientific civil service with a claim or grievance on promotion, working conditions, or related problems would ordinarily not handle the situation personally. He would submit his case to the local Whitley Council or to the Institution of Professional Civil Servants, which would then make an appropriate investigation and discuss the claim or grievance with persons on the appropriate management levels. The employee would normally accept as final the outcome of this negotiation, but has the right of appeal to the permanent secretary of his department and even to the Minister. Similarly, in any problems affecting the scientific civil service as a class, the Institution of Professional Civil Servants would be the agent for proposing and negotiating a remedy.

Table 1. Personnel and pay in the British scientific civil service (*5*). The fraction ½ in the "Personnel" columns means that administrative arrangements give certain individuals some of the advantages of the higher rank.

Position	Personnel			Annual pay (£)
	Established	Temporary	Total	
Scientific officer class				
Posts above chief scientific officer	19	3	22	4500 3750 3250 2850
Chief scientific officer	33		33	2600
Deputy chief scientific officer	113½	7½	121	2050–2225
Senior principal scientific officer	388	17½	405½	1700–1950
Principal scientific officer	1128	107½	1235½	1245–1595
Senior scientific officer	807	104	911	1070–1245
Scientific officer	390	298	688	513 10s–925
Total	2878½	537½	3416	
Experimental officer class				
Chief experimental officer	46	2	48	1355–1595
Senior experimental officer	1198	85	1283	1125–1325
Experimental officer	2552	397½	2949½	790–960
Assistant experimental officer	1268	481½	1749½	320 10s–700
Total	5064	966	6030	
Assistant (scientific) class				
Senior assistant	938	84	1022	605–815
Established assistant	1674		1674	280 10s–575
Temporary assistant		2582	2582	240 10s–523 10s
Total	2612	2666	5278	

Retirement

Retirement in the British civil service is set up on a noncontributing basis. Upon reaching the minimum retirement age, normally 60, an employee who has had at least 10 years' service may retire with a pension calculated at the rate of 1/80 of his average annual salary during the last 3 years of his service for every completed year of service, subject to a maximum of 45. In addition, he receives a tax-free lump sum calculated at the rate of 3/80 of his average salary for every completed year of service. For example, a man with 40 years of experience would retire at half the annual pay of the average of his last 3 years of employment, and in addition he would receive a tax-free lump sum payment of 1.5 times his average 3-year salary.

Evaluation

A broad evaluation of the advantages and disadvantages of British civil service policies and methods for management of the scientific and supporting staff shows the following positive values:

1) Sensitivity toward the special personnel requirements of creative scientific research work exists at top management levels in the British Civil Service Commission and in the employing departments. This is reflected in the organization of the departments and of the Civil Service Commission, whereby they give full consideration to recruitment and management of scientific personnel.

2) Members of the scientific civil service regard themselves as a separate corps with their own leadership. This enhances their morale and prestige. Scientists have a voice in recruitment, promotion, training, and matters of working conditions. Harmonious working relationships exist between the Civil Service Commission and the employing departments.

3) There is consistent and uniform application of the principle that scientists and their accomplishments may only be properly and acceptably evaluated by their peers. This is the basis for the use of a panel of senior scientists in major administrative areas. This panel is used to advise authoritatively on suitability for permanent appointment, to decide on promotions to higher grades, and to select candidates for appointment from within the service to the scientific officer class.

4) Channels of communication for discussion, understanding, and solution of personnel problems exist at all management levels between the staff and the top management of the employing departments. First, the top reporting relationship of the chief scientist of a department and his dual role as the spokesman for the unified scientific service of which he is the chief within the department are major factors in obtaining top-level con-

sideration of significant personnel needs. Second, the Institution of Professional Civil Servants, a staff association that is officially recognized by the Treasury and by the departments, acts as a representative spokesman and negotiator for the scientific staff as a whole or for individual scientists, on any policy, practice, or problem requiring top-level decision by the head of the department, by the Treasury, or by Parliament. If necessary, the Institution of Professional Civil Servants may carry a case beyond the Minister to an arbitration tribunal set up in the Ministry of Labour. Third, the national and departmental Whitley Councils on which representatives of the employees—the "staff side"—and the representatives of top department management—"the official side"—meet to discuss and to decide on policies and practices affecting more than one occupational class of the civil service provide a clearing house for problems.

5) The tax-free substantial lump-sum payment at retirement and the noncontributing retirement system effective after 10 years of service at age 60 create a strong incentive for senior scientists to remain in the service.

6) Full recognition and use is made of policies covering fellowships, training at government expense at universities, encouragement of attendance at professional meetings, and paid advertising of vacancies in newspapers and journals.

7) The establishment of a policy that individual scientists with creative research talent may rise to top positions without administrative or supervisory responsibilities and assignment of complement for that purpose is an excellent incentive.

8) The interdepartmental scientific panel, which is composed of top scientists and establishment officers of the administrative class who represent their departments, as well as representatives of the Treasury, in overseeing the welfare of the scientific civil service and in promoting acceptance of government-wide policies that will improve the service is a major factor in assuring continuity of progressive policies.

Although the purpose of this report is to suggest that British experience might include concepts applicable to the management of scientists in the United States, it may be relevant to point out certain disadvantages from the American point of view of the British scientific civil service. These should, of course, be evaluated in the light of the very marked cultural differences between the two nations.

1) The promotion rate is considerably slower than it is in the United States. It is considered that an outstanding scientist will reach the grade of principal scientific officer in his early 30's or from 10 to 15 years after his entrance in the service two grades below.

2) The stratification among the three classes in the scientific service is sharply defined and reflects to some extent the national educational system. Opportunity for mobility upward toward the scientific officer class is limited, although it should be noted that the normal educational qualifications are waived in the cases of those who are promoted from class to class.

3) The rigid maximum age limit for entry into the scientific officer class makes it impossible, except in special cases, for individuals over 31 with the necessary scientific attainments to obtain permanent posts in the government service. However, as has already been noted, they may obtain temporary appointments and have the benefits of a special contributory super-annuation scheme. There are no such restrictions with regard to the other two (lower) classes, but it will be evident that there is a marked tendency in the United Kingdom to expect the young scientist to decide very early where his career lies and not to give him any great facilities for changing to government service after he has reached the age of 31.

4) The salary scales for the top positions in the scientific class are not at a parity with top positions in the administrative class. This places the scientific civil service in a position secondary to that of the administrative class in the civil-service structure and culture.

In summary, there are many areas in the management of scientific personnel where the British have made valuable progress to be noted by other public civil-service systems that employ scientists. In common with the public service in other countries, many pressing problems constantly face them in their struggle to obtain and keep a fair share of creative scientific talent in the face of a national shortage of supply. The British civil service is alert to this challenge and continuously strives to meet it through a personnel system that features careful selection, professional development, and development of trust on the part of those who are members of the service in the major administrative decisions as made by their fellow scientists.

References

1. *The Scientific Civil Service. Reorganization and Recruitment During the Reconstruction Period.* Cmd 6679 (Her Majesty's Stationery Office, London, 1945).
2. *Report of Her Majesty's Civil Service Commission.* For period 1 April 1954 to 31 March 1955. Cmd 968 (Her Majesty's Stationery Office, London, 1955).
3. *Scientists in the Civil Service* (Scientific Branch, Civil Service Commission, London, 1954).
4. *Staff Relations in the Civil Service.* H. M. Treasury (Her Majesty's Stationery Office, London, 1955).
5. *Royal Commission in the Civil Service, 1953–1955.* Report Cmd 9613 (Her Majesty's Stationery Office, London, 1955).

Uptake and Turnover of Calcium-45 by the Guppy

Harold L. Rosenthal

The possible contamination of marine and fresh water supplies with radioactive materials was forcefully indicated following the 1954 atomic bomb tests carried out in the Pacific islands. Although the prospect of wartime contamination from detonation of atomic weapons is remote, accidental pollution of water supplies may occur during efforts to dispose of radioactive by-products from peacetime usage of radioactive materials. Contamination of water supplies may also result in the accumulation of radioactivity in food fishes. Such accumulation may adversely effect the nutritional economy and medical status of the world's population.

Andrews (*1*) has recently indicated that if the fission products of a nominal atomic bomb were mixed into the water of Lake Mead, an individual would have to drink 50,000 cubic feet of water to reach the tolerance value for strontium-90. However, if one assumes that fission products from waste effluents or bombs are not evenly distributed but may be concentrated in relatively local areas of the oceans or of bodies of fresh water for a given period of time, an entirely differ-

The author is chief biochemist in the division of biochemistry, department of pathology, Rochester General Hospital, Rochester, New York. This article is based on a report given before Section F–Zoological Sciences at the 1955 Atlanta meeting of the AAAS.

ent situation may occur. It is conceivable that migratory fishes such as salmon, tuna and others may accumulate sufficient radioactivity in one area and transport this activity to another area some distance from the original source of contamination. Furthermore, fishes are able to concentrate and retain radioactive nuclides in their tissues (*2–5*) for various lengths of time, depending on the nuclide and its physicochemical and biological half-life. The tremendous increase in the production and use of radioactive materials has accentuated the need for information concerning this problem. Although various investigations have been carried out and have appeared as reports of the U.S. Atomic Energy Commission (*2–4*), few articles are available in the formal literature (*5*).

In conjunction with other studies (*6*), it was necessary to obtain information concerning the rate of uptake of calcium-45 from water, and the rate of turnover of this nuclide by the guppy, *Lebistes reticulatus*. The data I have obtained may be of interest to a wide segment of the scientific community, and they form the basis for this article.

Experimental Detail

Normal, wild-type, adult male guppies were obtained commercially, and lordotic guppies were raised in our laboratory (*7*). The fish averaged about 125 milligrams in weight (70 to 230 milligrams), and they were approximately 3 to 8 months old. The animals were fed commercial dried food supplemented daily with frozen brine shrimp and tubifex worms when available. The temperature of the aquariums was maintained at 22° ± 3°C (*7, 8*).

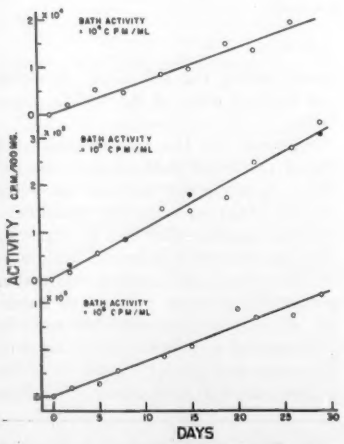


Fig. 1. Uptake of calcium-45 by wild-type *Lebistes* versus days in water containing the isotope. Open circles represent two to four fish; closed circles, five to six fish.

For analyses of radioactivity, fish were removed with a net, sacrificed by immersion in boiling water for 1 minute, rinsed with tap water, blotted on cellulose tissue, and weighed to the nearest milligram. In some experiments, tissues were obtained by dissection with needles, and the representative tissues were weighed to the nearest 0.01 milligram (Roller Smith 25-milligram torsion balance). The fish or tissues were digested in 0.25 to 1.0 milliliters of nitric acid for 1 to 2 hours with the aid of steam at 100°C. The digests were diluted with 1 to 10 milliliters of distilled water, and 100-microliter aliquot portions were plated in desicoted stainless steel cups, dried slowly, and counted in a windowless gas-flow counter. A sufficient number of counts were taken to assure a statistical error below 5 percent. Appropriate corrections for self-absorption, when necessary, were made by weighing dried aliquot portions of the digests and by reference to a previously determined standard curve. Corrections for physicochemical decay were made in the usual manner. The efficiency of the counter was such that 1 millicurie of calcium-45 yielded approximately 10^9 counts per minute. The calcium-45 was obtained from Oak Ridge National Laboratory in the form of carrier-free calcium chloride.

Uptake of Calcium-45

The rate at which guppies take up calcium-45 was determined by placing 10 to 12 male fish in glass aquariums containing 500 milliliters of the isotope. At this population density, the quantity of radioisotope removed from the water by the fish was sufficiently low so that no changes in the concentration of radioisotope in the water could be observed. In order to compensate for physicochemical decay of the isotope and to replace water lost by evaporation, distilled water was added three times weekly in such a way that the isotope activity varied less than ± 5 percent during the experimental period.

The results obtained from these experiments (Fig. 1) demonstrate the rapid incorporation of radioactivity in the body of the fish. This incorporation was linear during the 29-day experimental period at all concentrations thus far tested. The rate of accumulation of calcium-45 is consistent and reproducible. Thus the results of a second experiment (closed circles) repeated about 4 months later with water containing 10^5 counts per minute, per milliliter of calcium-45 are identical with the results of the first experiment. Each open circle represents average data obtained on two to four fish; the closed circles describe data from five to six fish. Since some radioactivity might adhere to the mucoid substance

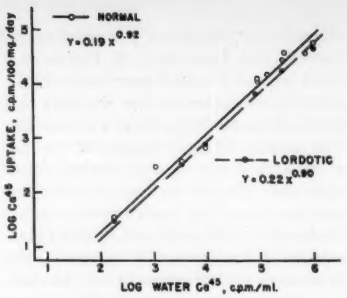


Fig. 2. Rate of uptake of calcium-45 by *Lebistes* versus activity of the water in which they were maintained. Each point represents data obtained on six to 30 fish in 12 experiments.

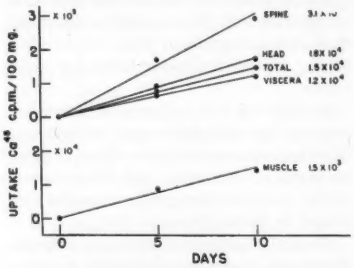


Fig. 3. Uptake of calcium-45 by various tissues from wild-type *Lebistes* versus days in water containing 1.8×10^5 counts per minute, per milliliter. Values for each tissue represent rate of uptake of calcium-45 in terms of counts per minute, per 100 milligrams, per day.

covering the surface of the fish by adsorption, the quantity of nuclide adsorbed in this manner was determined by analyzing fish that had been dipped in the experimental aquariums for 1 to 2 minutes. Although the adsorbed activity was relatively low, ranging from 0 to 5 times more than that absorbed by the undipped controls, all data were corrected for this activity.

The linear relationship between the amount of calcium-45 taken up by the body of the fish and the time in which the fish were immersed in radioactive water of constant activity appears to be in contrast with the reports of Lovelace and Podoliak (*5*) and Prosser *et al.* (*2*). These investigators studied, respectively, the uptake of calcium-45 in trout and of strontium-89 in goldfish, and concluded that the rate of uptake of isotopes from water decreases with time. However, these authors plotted their data logarithmically. When their data are replotted in the form presented in this article, it is found that their data are consistent.

The concentration of calcium-45 used in these experiments during the short, 29-day experimental period had little, if

any, adverse effect on the fish. Although occasional fish died during the experimental period, these losses were entirely consistent with our experience and were to be expected. Since the relationship of rate of uptake with time is linear, many later experiments were performed during a shorter, 10-day period, which was long enough for the fish to accumulate sufficient activity for analysis.

The rate of accumulation of calcium-45 by the total body of both the lordotic and the wild-type guppy is related to the concentration of isotope in the water in which they swim (Fig. 2). When the logarithm of the rate of uptake of the isotope (counts per minute, per 100 milligrams, per day) is plotted against the logarithm of the specific activity of the external medium (counts per minute, per milliliter), it can be seen that the experimental data are adequately described in the form of logarithmic equations for both strains of fish. The lines of the graph were fitted to the experimental data by the method of least squares. It is evident that the slopes of the lines for both strains of fish are the same. However, unpublished data show that the rate of uptake of calcium-45 by the lordotic guppy is significantly lower than the rate for the wild strain. The relationship between the rate of uptake of calcium-45 and the concentration of nuclide in the external medium is essentially in agreement with Prosser's data (*2*) but differs from the data of Lovelace and Podoliak (*5*). The latter authors concluded that the uptake of calcium-45 from water is independent of the concentration of the isotope in the external medium. Apparently, the interpretation made by these investigators is based on insufficient data, for the experimental concentration differences of the water were too small to yield unequivocal data.

The various organs of the body such as the spine, head, viscera, and muscle also take up isotope in a linear fashion, but the rate of uptake differs for each organ as shown in Fig. 3. The spine, containing the highest concentration of calcium, accumulated calcium-45 at a rate that is twice as great as the rate of uptake for the total fish. Muscle tissue, however, accumulated the isotope at a rate that is one-tenth that for the total fish. The difference in the rate of uptake of spine and muscle appears to be consistent with the calcium concentration of the two tissues, for the spine contains about 12 times as much calcium as muscle tissue on a dry-weight basis (*9*).

On the other hand, the visceral organs accumulate the isotope at approximately the same rate as the total body. The relatively high rate of incorporation by the viscera in comparison with the rate of incorporation by muscle is presumably the result of the greater proportion of blood in visceral tissue which is in equilibrium with the absorption mechanism in the gills (*10*). Since the visceral tissues include the intestinal tract, it is possible that some of the activity was owing to activity in the intestinal contents and the feces.

The rate of uptake of radioactive calcium-45 depends to a considerable extent on the concentration of inactive calcium present in the water, as is shown in Fig. 4. These data were obtained by placing fish in water containing added amounts of neutral calcium chloride and the same amount of radioactive calcium-45. After a 10-day experimental period, the fish were sacrificed, and the rate of uptake determined. It can be seen that increasing the inactive calcium concentration decreases the rate of incorporation of calcium-45 by the total body of the fish in a manner consistent with a logarithmic function.

The effect of age on the rate of uptake of calcium-45 from water was determined by isolating pregnant female guppies until young were produced. When the young reached the required age, they were placed in water containing calcium-45 for 3 days, and the rate of uptake of the isotope by the fish was determined in the usual way.

Table 1. The uptake of calcium-45 by wild-type *Lebistes* of different ages. The water contained 10^6 counts per minute, per milliliter. The numbers in parentheses indicate the range of weight.

Age (day)	No. of fish* (pair)	Weight (mg)	Relative uptake† ± standard error‡
1	6	6.7 (5.4 to 7.5)	0.923 ± 0.004
20	5	13.2 (9.7 to 16.3)	0.921 ± 0.009
43	6	24.2 (15.9 to 38.9)	0.912 ± 0.007
78	9	85.1 (66 to 106)	0.888 ± 0.010
Adult (male)	8	113.1 (65 to 162)	0.793 ± 0.006

* Each pair represents an experimental animal and one dipped momentarily as its control.
† Relative uptake = log [(uptake in count/min, per 100 mg, per day)/(water activity in count/min, per ml)].
‡ Standard error = $[\Sigma d^2/n(n-1)]^{1/2}$.

Since sexual dimorphism does not become apparent in guppies raised under the conditions existing in this laboratory until 60 to 90 days of age, all young up to 43 days of age were considered to be male guppies. However, the 78-day-old guppies were selected when possible, and they represent the male sex for the most part. It is apparent (Table 1) that the rate of uptake of calcium-45 by young guppies is constant during the first 20 days of life but greater than the rate of uptake by adults. After the initial phase, the rate of uptake gradually decreases to that of the adult. Since the newborn guppy (*8*) contains less calcium (0.4 percent of wet weight) than the adult male (1.14 percent wet weight), the greater rate of uptake during the initial phases of growth corresponds to the period of maximal calcification of mineralized tissues.

Turnover of Calcium-45

The rate of turnover of calcium-45 was studied by placing fish in water containing isotope at a concentration of approximately 2×10^5 counts per minute, per milliliter for 10 days in order to incorporate sufficient isotope for analysis. The fish were then transferred to conditioned isotope-free water at a density of 20 fish per gallon, and they were transferred to new water at 3-hour intervals during the first day, at daily intervals for the next 4 days, and at 5-day intervals thereafter. All data have been corrected for natural decay of the nuclide.

The loss of radioactivity (Fig. 5) from the total fish may be divided into three major components that are adequately described by first-order reactions varying from very fast to very slow. The first rapid component, with a biological half-life of 3 days, represents loosely bound calcium-45 derived from soft body tissues and body surfaces of the fish. A second component, with a biological half-life of 137 days, presumably represents more tightly bound calcium-45 in muscle and connective tissues. A

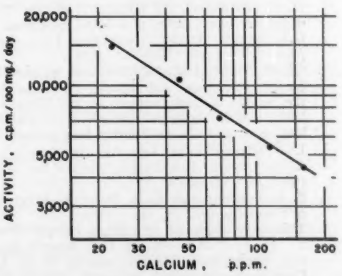


Fig. 4. Activity of calcium-45 incorporated by wild-type *Lebistes* versus concentration of inactive calcium contained in the water. Each point represents rate of uptake determined on five to six fish. The water contained 1.4×10^5 counts per minute, per milliliter (see Fig. 3).

very slow third component represents calcium-45 which is incorporated in bone and other osseous tissues such as the scales, fin rays, and so forth. This component has a biological half-life of at least 300 days. Other components with longer half-lives may be present. The short experimental period does not permit a better approximation, but it has not been possible to maintain the animals for a longer length of time under the experimental conditions used.

In some experiments, the loss of calcium-45 from viscera, muscle, head, and spine was determined as shown in Fig. 6. It is apparent that visceral tissues lose most of the calcium nuclide during the first few days. The rapid loss corresponds to the first short half-life component illustrated in Fig. 5. However, small amounts of the isotope were still present in the viscera after the fish had been in isotope-free water for 40 days. Since the visceral tissues include the intestinal tract, the residual radioactivity may represent calcium ion which is being excreted. Muscle tissue loses radioactive calcium more slowly than the viscera and apparently corresponds to the second component ($T_{\frac{1}{2}} = 137$ days) discussed in the preceding paragraph.

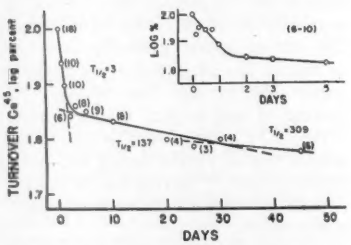


Fig. 5. Turnover of calcium-45 by wild-type *Lebistes* versus days in water containing no isotope. The figures in parentheses indicate number of fish averaged from four experiments. The inset depicts an expanded representation during the first 5 days. Fish contained about 10^6 counts per minute, per 100 milligrams on day zero of turnover.

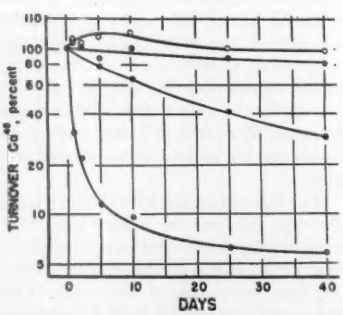


Fig. 6. Turnover of calcium-45 by various tissues from wild-type *Lebistes* versus days in water containing no isotope. Each point represents average data on four to 10 fish from four experiments. ○, spine; ⊖, head; ●, muscle; ⊖, viscera. Fish contained about 10^5 counts per minute, per 100 milligrams on day zero of turnover.

Table 2. Distribution of calcium-45 in tissues of wild-type male *Lebistes*. The numbers in parentheses indicate number of fish analyzed.

	Uptake ± standard error (10 days)		Turnover ± standard error (40 days)	
	Body weight (%)	Distribution (%)	Body weight (%)	Distribution (%)
Carcass	100.0 ± 7.26 (15)	100.0 ± 2.92 (15)	100.0 ± 4.02 (7)	100.0 ± 5.43 (8)
Head	19.7 ± 0.42 (14)	21.3 ± 1.12 (14)	19.1 ± 1.09 (7)	34.4 ± 2.08 (7)
Viscera	12.7 ± 0.49 (14)	7.3 ± 0.48 (14)	11.6 ± 0.32 (6)	0.5 ± 0.04 (5)
Muscle*	40.0 (14)	3.7 ± 0.31 (14)	40.0 (5)	2.6 ± 0.46 (5)
Spine	2.8 ± 0.15 (14)	6.2 ± 0.36 (14)	2.8 ± 0.21 (7)	19.4 ± 1.04 (7)
Remainder†	24.8 ± 0.44 (13)	61.5 ± 2.32 (13)	26.5 ± 1.02 (8)	43.1 ± 2.38 (6)

* Muscle tissue estimated to comprise 40 percent of body weight. † Calculated by difference.

In contrast to viscera and muscle, the spine continues to incorporate calcium-45 for the first 10 days the fish are placed in inactive water. The additional calcium-45 is presumably obtained from redistribution of the isotope from tissues in which it is only loosely bound. Thereafter, the rate of calcium turnover is exceedingly slow. An approximation of the biological half-life of the calcium-45 of the spine estimated from the last 15 days of the experiment is about 600 days or more. The head, consisting largely of osseous tissues, behaves in a fashion similar to the spine but with some of the characteristics of softer tissues.

Distribution of Calcium-45

The distribution of calcium-45 in various tissues at the end of 10 days of uptake from isotopic water and after 40 days turnover is shown in Table 2. The differential accumulation of the isotope in osseous tissues is evident. Thus, the spine, which comprises only 2.8 percent of the body weight, accounts for 6.2 percent of the total body radioactivity after 10 days of uptake and 19.4 percent of the total activity after 40 days of turnover. On the other hand, muscle tissue comprises about 40 percent of the body weight but contains only 3.7 percent of the total body activity after 10 days of uptake. The viscera, however, accumulate a good deal of the isotope which is turned over at a very rapid rate, as has been shown. The data shown in Table 2 are necessarily arbitrary because it was necessary to assume that muscle comprises 40 percent of the body weight. The remainder of the fish includes the scales, skin, fins, and ribs, and amounts to about 25 percent of the body weight. Since most of this residue is composed of osseous tissues, it is not surprising that this tissue accumulated about 62 percent of the total activity in the body of the animals. The distribution of calcium-45 in muscle tissue of *Lebistes* is similar to the distribution of this isotope in muscle tissue of the salt-water *Tilapia* (*11*).

Conclusions

It is apparent from these studies that fish accumulate considerable quantities of calcium-45 and other radioactive nuclides (*2–5*) from the water in which they swim. Many radioactive elements such as calcium-45, carbon-14, strontium-90, and others become fixed in osseous tissues and may remain in these tissues for a long time. Although this article deals only with calcium-45, a relatively short-lived isotope ($T_{\frac{1}{2}} = 163$ days), bone seeking elements with longer half-lives, such as strontium-90, ($T_{\frac{1}{2}} = 25$ years), may remain in osseous tissues in significant quantities throughout the life of the fish. With incorporated calcium-45, however, natural decay of the nuclide would remove about 75 percent of the activity in a year.

References and Notes

1. H. L. Andrews, *Science* 122, 453 (1955).
2. C. L. Prosser *et al.*, "Accumulation and distribution of radioactive strontium, barium-lanthanum fission mixture, and sodium in goldfish," *U.S. Atomic Energy Comm. Tech. Inform. Service M DDC-496* (1945).
3. L. A. Krumholz, "A summary of findings of the ecological survey of White Oak Creek," *U.S. Atomic Energy Commission Tech. Inform. Service No. ORO-132* (1954).
4. R. W. Hiatt *et al.*, "Radioisotope uptake in marine organisms with special reference to the passage of such isotopes as are liberated from atomic weapons through food chains leading to organisms utilized as food by man," Univ. Hawaii Marine Lab. Ann. Rept. to U.S. Atomic Energy Commission, project No. AT (04-3)56, (1954–55).
5. F. E. Lovelace and H. A. Podoliak, *Progressive Fish Culturist* 14, 154 (1952).
6. This study was aided by a grant, contract No. AT (30-1)-1712, from the U.S. Atomic Energy Commission. We are grateful to H. I. Cundiff, for technical assistance, and to E. Pfluke, Pfluke's Pet Shop, Rochester, N.Y., for animals and supplies.
7. H. L. Rosenthal, *Biol. Bull.* 102, 30 (1952).
8. ———, *ibid.* 105, 160 (1953).
9. ———, *Nature* 173, 693 (1954).
10. A. Krogh, *Osmotic Regulation in Aquatic Animals* (Cambridge Univ. Press, London, 1939).
11. H. Boroughs, Univ. of Hawaii Marine Laboratory, personal communication.

A. H. Hersh, Geneticist

Amos Henry Hersh was born on 2 November 1891 in Quarryville, Pennsylvania, a village near Lancaster. In the latter town, he attended the Boys' High School and, later, Franklin and Marshall College, where he was graduated with an A.B. degree in 1914. He remained in Lancaster another year and attained the M.A. degree in 1915.

His interest in developmental zoology attracted him to Edwin Conklin, whose assistant he became in 1915. Thus began his teaching and research career. From 1916 to 1918, he held an instructorship at Kansas State College and, the following year, a similar appointment at Marquette University.

A new phase in his scientific career began with his appointment as fellow in zoology at the University of Illinois in 1919. Again, development was the attraction, and Charles Zeleny, embryologist and geneticist, gladly accepted him as a graduate student in the promising field of genetics. Zeleny had the gift of opening the eyes of students to genetics, then the infant child of the biological sciences. Hersh came to the University of Illinois during the exciting years when "Uncle" Henry B. Ward was head of the zoology department, Victor Shelford was pioneering in ecology, H. B. Lewis in biochemistry, Harley van Cleave in invertebrate zoology, Kudo in parasitology, and John Sterling Kingsley, a creative morphologist, was rounding out a life of teaching and research in comparative anatomy. This was the exciting environment in which Amos Hersh found himself during his 3-year association with the zoology department of the university.

His studies culminated in a Ph.D. degree, awarded in 1922. Here too, he met his future wife, Roselle Karrer, also a graduate student in Zeleny's laboratory, whom he married in 1922. Two sons were born to them.

Except for 1 year at the University of Michigan (1923), Dr. Hersh spent the remainder of his life in teaching and research at Western Reserve University, where he was advanced in due course from assistant professor to full professor. From the very beginning of this association, he carried on intensive research studies. In his 32-year tenure he published more than 50 papers, beginning with *Drosophila* studies and expanding into allometric growth and human heredity problems.

His contributions to genetics, in a sense, are threefold: determination of rates of facet-formation in relation to temperature in the bar-eyed series in *Drosophila*, a study instigated by Zeleny and his group; application of the allometric growth formula to developmental problems, including contributions to theoretical genetics; and a series of studies on human heredity, together with Robert M. Stecher and others. Each of these approaches yielded fruit. His desire to reduce biological processes to simple quantitative mathematical relationships was outstanding. This is evident throughout all his work. His early work on the application of the relative growth equation to evolutionary processes is but a single example of this mathematical unification.

This phase resulted in an unusual and frequently quoted study, *Evolutionary Relative Growth in the Titanotheres* (1934), in which Hersh "tested in an admirable way" [Goldschmidt, *Physiological Genetics* (McGraw-Hill, New York, 1938), p. 211] the phylogenetic significance of the theory that form was a type of automatic pattern formation, that "something connected with growth produced at a definite time and place and in a definite quantity sets the pace for the working of differential growth by fixing the numerical value of the constants in the formula." Later he extended this concept to the antero-posterior gradient studies in the *Notonecta*. After this, he ingeniously demonstrated that this growth function could be applied to the study of the development effects of genes. This was the work on the bar-eyed mosaics in *Drosophila*, in which one of us (F. DeM.) was fortunate to have a share.

More recently, he turned from theoretical genetics to human genetics. In this phase, he worked with another keen student of human heredity, Stecher. With Hersh's theoretical knowledge and Stecher's long clinical background, along with the assistance of several others, the two formed the core for investigations in the young field of human genetics. This friendly association led to the study of numerous problems, such as gout, the heredity of ankylosing spondylitis, genetics of rheumatoid arthritis, Heberden's nodes, hyperuricemia, and the inheritance and development clinodactyly. Just prior to his death on 28 August 1955, he published with O. P. Kimball a paper on the genetics of epilepsy. Three other papers in this general field have appeared posthumously in various journals.

Our association with Hersh spanned almost 26 years. We are happy to state that after our frequent conferences with Hersh, often quite brief, we were invariably the gainers. Some observation, an explanation, a witticism sometimes incisive, bespoke the clarity of his thought. His undergraduate students at times could not understand him; he assumed intelligence on their part and his expositions might omit steps, that they, in the throes of learning to think, felt necessary. At the graduate level students began to appreciate more fully his clarity, accuracy, and logic as well as the implications of his observations. He became recognized as one of the best minds on the campus. His Alma Mater, Franklin and Marshall College, in recognition of his attainments, awarded him an honorary D.Sc. degree in 1946.

Seemingly without ambition for preferment or honors, he nevertheless gave evidence of a quiet inner driving force that did not desert him even in the last 2 or 3 years of his life, when, in spite of failing health, he remained alert and active in his teaching and in his researches.

D. P. QUIRING
Western Reserve University
Cleveland, Ohio

F. DEMARINIS
Fenn College, Cleveland, Ohio

News of Science

Indians in the Peruvian Andes

Biological studies of an isolated human group of some 1700 Vicos Indians who live in a high, cold valley in the Peruvian Andes, the Callejon de Huaylas, have been carried out during the past 6 months at a 36,000-acre hacienda rented and operated by Cornell University. These studies, made possible by Cornell's field facilities and by National Science Foundation and U.S. Public Health Service grants, were organized by Marshall T. Newman, associate curator of physical anthropology at the Smithsonian Institution.

He made physical studies on the Indian school boys and men and found them to be very small—almost dwarfed in stature and especially low in body weight. The adult man averaged less than 5 feet 1 inch in stature and 114 pounds in weight. The boys were puny and underdeveloped. On the other hand, many of the men were sturdy and well muscled and had very large lung capacity, enough to supply oxygen for heavy work at 10,000 to 12,000-feet altitude. Only one or two out of more than 200 men could be considered fat by our standards. In large part their inadequate diet, the heavy work, and the cold, high environment may account for the small average size of these people and the poor development of the boys.

The adequacy of the diet was tested by Carlos Collazos, head of the department of nutrition in Peru's Ministry of Public Health. He studied the signs of dietary inadequacies in the schoolboys, and his laboratory is making vitamin analyses of their blood. In addition, a Peruvian dietitian, Carmen Carceres, weighed and analyzed what a sampling of Indian families ate each day, and a Peruvian anthropologist, Hector Martinez, added a supplementary study of the food customs and habits of the people.

These studies have not been fully analyzed, but provisionally the schoolboys seem to be principally lacking in vitamins A and B_2. This will be tested by blood analyses. The family food study, which is now complete, suggests that the greatest deficiencies are in calcium and vitamin-A intake and that the diets are universally very low in fats.

Fred H. Allen, Jr., associate director of the Blood Grouping Laboratory, Boston, Mass., made studies on the Indians' blood types and ran hemoglobin tests on the schoolboys. Among other things, the blood types indicate that the Vicos Indians are almost completely pure in a racial sense. Provisionally, the hemoglobins seemed low. The serum provided by Allen is being analyzed for extra information on vitamin deficiencies, and the Public Health Service is making a study of the cholesterol level of the blood as part of the heart study. Judging by the fat-deficient diet, the cholesterol levels should be low. Along with the low blood pressures shown by Newman's study, and the apparent almost complete lack of heart disease among the Indians, low cholesterol levels should be especially significant.

A final study, made possible by the cooperation of Ramon Vallenas, subdirector of Peru's Department of Industrial Hygiene, consisted of x-rays of the schoolboys' hands. These x-rays will provide information on bone density, likely to reflect poor calcium intake, and on bone development, which, for dietary and other reasons, may be considerably retarded.

The purpose of these studies is to correlate the poor soils, inadequate diet, cold living conditions, and poor sanitation—most of the people have intestinal worms—with the physical and medical status of these Indians, who are forced to eke out a bare subsistence in a relatively inhospitable environment.

How Many Chromosomes?

Strong evidence now indicates that generations of biology students have been erroneously taught that the number of chromosomes in normal human cells is 48. In a paper delivered at the First International Congress of Human Genetics which met in Copenhagen in August, J. H. Tjio and A. Levan showed exceptionally fine microphotographs of chromosome configurations in human embryonic lung fibroblasts. Their findings have been published in *Hereditas* [**42**, 1 (1956)].

Tissue cultures from four embryos were subjected to a mild hypotonic treatment to spread the chromosomes apart, and then to a colchicine solution to stop cell divisions in metaphase; next they were smeared under light pressure in acetic orcein stain. The count of chromosomes, in 261 out of 265 undamaged cells, was 46. In four cells there were 47 or 48, the extra chromosomes having perhaps been displaced from adjacent cells in the smearing process. There are ten pairs of chromosomes with median or submedian kinetochores (spindle attachment points), ten pairs with subterminal kinetochores, and three pairs, all relatively small but not the smallest in size of the chromosomes, with almost terminal kinetochores.

These findings will of course require extensive corroboration, from counts on germ cells as well as on a variety of somatic tissues. Many persons have tried in the past to make a definitive count of the human chromosomes, but until the new spreading technique, discovered by T. C. Hsu, was available, it was no easy matter because of the large number of chromosomes and the frequency with which they tend to overlie each other. Only last year C. D. Darlington and A. Haque reported in *Nature* a count of 48 chromosomes in a human bone-marrow cell. As for the anthropoid apes, there has been no reliable study of the chromosome number in even a single species.—B. G.

International Cooperation in Uranium Exploration

A program for continuing and extending cooperation with friendly nations in the field of uranium exploration has been approved by the Atomic Energy Commission. It is believed that the rapid increase in the scope of atomic progress, especially the potential development of nuclear power, will stimulate the development of uranium resources in many nations to meet their own future requirements for civilian uses of nuclear energy. The United States offers assistance to those nations in their uranium exploration programs along the following lines:

1) Access to information on uranium geology and exploration techniques. The United States has made substantial contributions to world knowledge in this field. (Several hundred reports on various aspects of uranium exploration and ore recovery are included in the technical libraries that, to date, the United States has given to 42 countries.)

2) Geologists and technicians in interested countries will be encouraged to visit the United States and study uranium deposits and commission exploration and laboratory projects.

3) AEC geologists, upon request, may

make brief visits to other nations to discuss uranium geology and exploration techniques and make brief preliminary investigations of known uranium deposits and favorable areas.

These activities may develop into cooperative foreign exploration projects similar to those approved by the commission over the past several years. Since 1951, projects varying from a month to several years in duration have been or are being carried out with Australia, Bolivia, Peru, Venezuela, Colombia, the Philippines, and Turkey, with brief preliminary appraisals made in a number of other countries.

National Seed Storage Laboratory

The U.S. Department of Agriculture has announced that Colorado Agricultural and Mechanical College, Ft. Collins, has been selected as the site of a new National Seed Storage Laboratory—a facility to store valuable germ plasm for future use in developing better crops. Funds totaling $450,000 for construction of the laboratory were included in an appropriation bill passed by Congress this year. The laboratory site, donated by the college, will be deeded to USDA.

Lack of an adequate national seed-storage facility has in the past resulted in partial or complete loss of potentially valuable breeding stock. Existing state and federal laboratories and experiment stations can handle plant material needed in current breeding programs, but they are not equipped to provide adequate storage of the thousands of different plants introduced from abroad or developed in this country that might have value in future plant-breeding research, even though not required for immediate use.

U.N. Exhibit to Commemorate Geneva Nuclear Conference

A permanent exhibit that is to serve as a reminder of the historic significance of the atomic energy conference held at Geneva last summer has gone on display at United Nations Headquarters in time for the conference that has convened there to establish a new world atomic energy agency. The exhibit is intended to commemorate the first International Scientific Conference on the Peaceful Uses of Atomic Energy, which brought together 1428 delegates and scientists from 73 nations, as well as 1334 observers.

Invitations were sent by the Secretary-General last November to the seven governments that had exhibited models of atomic reactors or power plants at the Geneva conference. The governments concerned accepted the Secretary-General's suggestion that they send displays to form the principal parts of the new exhibit at U.N. headquarters. The seven governments are Canada, France, Norway, Sweden, the U.S.S.R., the United Kingdom, and the United States.

Archeology in Alabama

The National Geographic Society has announced that a record of human life in North America reaching back 8000 years has been unearthed in a limestone cave near Bridgeport, Ala. The society and the Smithsonian Institution have jointly excavated the cave.

Layer by layer, a cross section of bones, tools, and weapons has been peeled from the floor of the cave (Russell Cave). It shows human occupancy from 6200 B.C., or earlier, to A.D. 1650. Instead of sweeping out their litter, the cave dwellers buried it under fresh layers of earth, leaving a record that is easy to read.

Led by Smithsonian archeologist Carl F. Miller, the expedition has dug down 14 feet. Remains of a man-made fire at that point have been dated by radioactive carbon tests as being 8160 years old, plus or minus 300 years. At the 6-foot level the group found a skeleton of a cave Indian who died about 4000 years ago.

The topmost Indian deposits, under a layer of debris left by modern picnickers, show no trace of white man's objects, dating them to about 1650, before the first white traders appeared in northern Alabama. Below, the small stone arrowheads of the Woodland period, roughly A.D. 1100 to 1000 B.C., give way to earlier spearheads and knives that represent a time before the bow and arrow were known. Changes in the quality of pottery fragments, and their disappearance beneath the 5-foot level, mark the line between the Woodland culture and the older Archaic Age, when only baskets and skin vessels were in use. The Geographic Society has reported that no other site in North America has yielded such a detailed record covering so long a period of occupancy.

Organized Labor and the New Michigan Reactor

Two international labor unions have filed petitions with the Atomic Energy Commission aimed at blocking construction of the neutron-breeder reactor that is to be built at Lagoona Beach, Monroe County, Mich., for which the AEC has granted a "conditional" permit [*Science* **124**, 358 (24 Aug. 1956)]. The International Union of Electrical, Radio and Machine Workers (AFL-CIO) says that the reactor would be a "catastrophic threat to the . . . citizens of Detroit and . . . of Toledo, Ohio, both 30 miles from Lagoona Beach. [The danger] lies in the possibility of the reactor exploding or otherwise going out of control." The United Automobile Workers of America (AFL-CIO) maintain that the AEC has violated the Atomic Energy Act of 1954 in issuing the conditional construction permit without holding formal hearings. The UAW petition states that the plant as planned raised questions as to "reasonable assurances" of the safety of the project.

Borneo Zoological Expedition

Robert F. Inger, curator of amphibians and reptiles at Chicago Natural History Museum, has returned to this country after having led a zoological expedition to Borneo that has been in the field since March. On two occasions he was the house guest of Iban families in their apartments in the tribal longhouses—huge wooden structures on stilts that are as much as 1000 feet long. These buildings house a whole village of 300 or more people.

Inger collected about 1000 frogs, 5000 fishes, and several hundred snakes, lizards, mammals, and other specimens for the museum. He traveled for hundreds of miles on the Rejang, Kinabatangan, and Kalabakan rivers in dugouts equipped with outboard motors. The tribesmen acquire the motors by going off for several months and working for wages in British-owned oil fields and timber camps. When they have enough money saved to buy an outboard, they quit their jobs and return to a motorized version of their old way of life.

TB in the United States

Approximately 80,000 new cases of active tuberculosis are being reported in this country each year, despite the great advances that have been made in the effort to combat tuberculosis, according to the Annual Report of the National Tuberculosis Association. Outstanding among the advances cited by the report is the revolution in treatment that began 10 years ago with the introduction of effective new drugs. But the report points out that, at best, the victory over the disease is only a partial one:

"According to latest estimates, there are more than 1,200,000 people with active or inactive tuberculosis in the United States. They need either treatment or medical supervision. About 800,000 have active cases of infectious tuberculosis. Perhaps 250,000 of these are not under treatment and are exposing others in their communities. About 55 million

Americans, roughly one in three, are infected with the tubercle bacillus.

"The sharp decline in death rate, one of the most dramatic and best publicized recent developments, seems a less glorious victory when it is realized that last year about 16,000 persons died from tuberculosis, a preventable disease."

British Research Budget

Britain is devoting 60 percent of her budget for scientific research and development to national defense. The figure is 34 percent for the United States.

On a proportional basis, Britain probably is spending as much of the wealth she produces each year on research and development as the United States, if not more. Altogether, however, U.S. expenditures on civil research and development are 10 times as great as those of the British.

These figures were given at the recent meetings of the British Association for the Advancement of Science. They had been compiled by Ernest Rudd of the intelligence division of the Deparment of Scientific and Industrial Research.

Abortion in the U.S.S.R.

On 23 Nov. 1955 the Presidium of the Supreme Soviet of the U.S.S.R. passed a decree repealing the prohibition on abortion that had been in force for almost 20 years. This is the third time in the 39 years of its existence that the Soviet Union has changed its stand on the question of permitting or prohibiting abortion on other than "therapeutic" grounds. Soviet legislation on abortion falls into four distinct periods: 1917–20, in which abortions were illegal, even on medical indications; 1920–36, in which abortions were legal provided that certain conditions were met; 1936–55, in which abortions again were illegal, except on certain medical indications; and 1955 to the present, in which abortions are again legal.

Radiation in Monkeys

A long-term research project to study the effects of atomic radiation on monkeys throughout their entire lifetime will begin at the University of Wisconsin this year. The study will be started with an initial grant of $172,500 from the National Institutes of Health; this amount will finance work during the first year of the program.

To house the project, the Wisconsin Alumni Foundation has agreed to construct a $250,000 addition to the ARF building, which is used by the university's Primate Laboratory. Rent on the addition, to be used exclusively for the radiation project, will come from overhead on federal contracts.

The project will have two broad purposes: to learn the direct effect of radiation damage upon the physiological function of the various organs; and to use radiation as a tool in studies of aging. The research will be directed by Harry Harlow, director of the Primate Laboratory; John Z. Bowers, dean of the University of Wisconsin Medical School; D. Murray Angevine, professor of pathology; Van R. Potter, professor of cancer research; Robert F. Schilling, professor of medicine and cancer research; and Paul H. Phillips, professor of biochemistry.

News Briefs

■ Three American astronomers went to the U.S.S.R. this month to attend the dedication of the Buraken Astrophysical Observatory of the Armenian Academy of Sciences, in Russian Armenia, 8–24 Sept., and to participate in a symposium on nonstable stars that was held during the same period. The group included Nancy G. Roman of the Naval Research Laboratory, Washington, D.C.; George H. Herbig of the University of California's Lick Observatory; and Jesse L. Greenstein of the Mount Wilson Observatory of the California Institute of Technology.

■ A telephone that transmits pictures along with sound so that users may see each other on a 2- by 3-inch screen has been developed by Bell Telephone Laboratories. The instrument is the first system of its kind to use a pair of ordinary telephone wires. It has been in operation on an experimental basis between New York and Los Angeles.

■ The Australian Government has announced that it will undertake the first marsupial census ever made. The survey will begin in New South Wales, where there are more than 40 marsupial species. The animals range in size from a 3-inch mouselike marsupial to the great gray kangaroo that measures 6 feet. The settlement of the country and the introduction of the fox have been fatal to many species, some of which have entirely vanished, while others have been so reduced in numbers that they are on the verge of extinction.

■ Members of the British North Greenland Expedition were permitted to sleep at any time during the 24-hour Arctic night, and they went to bed and took naps at all times. However, when the amount of sleep was totaled up for a month, it was found that each man averaged a conventional 7.9 hours of sleep per day. H. E. Lewis and J. P. Masterton of the Medical Research Council, London, reported these findings at the recent meeting of the British Association for the Advancement of Science.

Scientists in the News

WESLEY T. HANSON, JR., head of the color photography division of the Eastman Kodak Research Laboratories, Rochester, N.Y., has been selected as the first recipient of the Herbert T. Kalmus gold medal award of the Society of Motion Picture and Television Engineers. The medal is awarded for "outstanding contributions in the development of color films, processes, techniques or equipment useful in making color motion pictures for theater or television use." Presentation will take place 9 Oct., during the society's 80th convention at the Ambassador Hotel in Los Angeles, Calif.

WARREN E. WILSON, George Westinghouse professor of engineering education at Pennsylvania State University, has been appointed dean of the Pratt Institute School of Engineering.

DONALD H. HALE, colonel in the Chemical Corps, U.S. Army, and commanding officer of the Chemical Warfare Laboratories, Army Chemical Center, Md., retired on 31 Aug. He was awarded a Certificate of Achievement for 32 years of superior service to the Army and the Chemical Corps. His command of the Chemical Warfare Laboratories climaxed a long association with research and development.

He received his Ph.D. in physics in 1940 from the University of California. Among his assignments in the Army were chief of the U.S. Army Radiological Defense School; chemical officer of the 7th Army, European Command; commanding officer of Dugway Proving Ground, Utah; chief of the Research and Development Division, Office of the Chief Chemical Officer. Hale has been appointed technical assistant to the manager of the Central Engineering Department of Food Machinery and Chemical Corporation in San Jose, Calif., effective 1 Oct.

BRUNO J. WOJCIK has been appointed manager of research and development for the industrial chemicals division of the Olin Mathieson Chemical Corporation. He joined the company in 1950 and has served in various research capacities. Two other new appointments are BERNARD H. NICOLAISEN, assistant manager of research and development in charge of the division's labo-

ratories at Niagara Falls, N.Y., and CHESTER WHITE, supervisor of the Rochester, N.Y., laboratories.

Four appointments to the staff of the John Jay Hopkins Laboratory for Pure and Applied Science have been announced by the General Atomic Division of General Dynamics Corporation: MARTIN O. STERN from Carnegie Institute of Technology, NORMAN ROSTOKER from Armour Research Foundation, and ANDREW W. McREYNOLDS and HARVEY P. SLEEPER, JR., from Brookhaven National Laboratory.

FRANCIS McCAFFREY, formerly of the Naval Ordnance Test Station at China Lake, Calif., has been appointed associate professor of physics at Boston College, where he will continue research in photoconductive mechanisms in semiconductors.

WARD C. SANGREN, a senior mathematician at Oak Ridge National Laboratory since 1951, has joined the General Atomic Division of General Dynamics Corporation, San Diego, Calif. He is known for his work on the solution of reactor problems through the use of high-speed calculating machines and for advanced theoretical work on boundary value problems, eigenvalue problems, and nonlinear differential equations.

SEWARD E. MILLER, chief of the Division of Special Health Services of the Bureau of State Services, U.S. Public Health Service, has been granted a leave of absence to accept the directorship of the University of Michigan's Institute of Industrial Health.

JOEL O. HOUGEN, professor of chemical engineering at Rensselaer Polytechnic Institute since 1948, has joined the engineering department of Monsanto Chemical Company's Research and Engineering Division, St. Louis, Mo. He will be a member of the newly organized section concerned with special research in automatic control of chemical processes.

CARL OLSON, JR., chairman of the department of animal pathology and hygiene at the University of Nebraska, has been named professor of veterinary science at the University of Wisconsin. He will fill the position vacated by CARL BRANDLY, who has accepted appointment as dean of the College of Veterinary Medicine at the University of Illinois.

RAY G. DAGGS has resigned as director of research for the Army Medical Research Laboratory at Fort Knox, Ky., to accept the position of executive secretary-treasurer of the American Physiological Society, Washington, D.C. MILTON O. LEE, former executive secretary, will continue as managing editor and as secretary of the Federation of American Societies for Experimental Biology.

RALPH S. MUCKENFUSS, former scientific director of the Naval Biological Laboratory at the University of California, has recently joined the staff of the Naval Medical Research Institute, Bethesda, Md., as technical director.

RICHARD H. GRAHAM, formerly chief of the reactor engineering section of the division of reactor development for the U.S. Atomic Energy Commission in Washington, D.C., has joined Lockheed's Missile Systems Division as staff scientist for nuclear engineering.

CHARLES F. KETTERING, inventor and General Motors research consultant, received a scroll from the American Medical Association at a celebration of his 80th birthday. The citation was in recognition of his contribution to science. More than 1000 attended the presentation, which took place in Dayton, Ohio.

CLYDE KLUCKHOHN, professor of anthropology in the Laboratory of Social Relations at Harvard University, has been named to the 2-year appointment of chairman of the division of anthropology and psychology at the National Academy of Sciences–National Research Council.

JONAS N. MULLER has been named professor and director of the department of preventive medicine, public health, and industrial hygiene at the New York Medical College, Flower and Fifth Avenue Hospitals. Muller, who has been with the American Public Health Association in New Haven, Conn., since 1952, succeeds HELEN WALLACE, who has gone to the School of Public Health at the University of Minnesota.

HENRY A. PILSBRY, conchologist who will be 94 years old in December, has returned to the Academy of Natural Sciences of Philadelphia after an absence because of illness. He is again in charge of the academy's department of mollusks, of which he is curator. He has been on the academy's staff for nearly 70 years.

Col. WARREN C. EVELAND, (MC) USA, has been appointed chief of the bacteriology and immunology section of the Armed Forces Institute of Pathology, Washington, D.C. Prior to reporting to his new assignment on 27 Aug., Eveland had been on duty at the Army's 406th Medical General Laboratory in Tokyo, Japan.

Recent Deaths

MARY BICKINGS-THORNTON, Philadelphia, Pa.; 76; professor emeritus of anatomy at Woman's Medical College; 7 Sept.

BENJAMIN M. DUGGAR, Pearl River, N.Y.; 84; research consultant at Lederle Laboratories; retired professor of botany at the University of Wisconsin; Member of AAAS Executive Committee, 1925; vice president AAAS Section G, 1926; 10 Sept.

ISAAC H. JONES, Los Angeles, Calif.; 75; pioneer in aviation medicine, who until recently was conducting research at the University of California; 7 Sept.

NORMAN McINDOO, Washington, D.C.; 75; retired senior entomologist in the insecticide division of the Department of Agriculture; 7 Sept.

OTTO Y. SCHMIDT, Moscow, U.S.S.R.; 64; geographer and mathematician, who at various times was on the staff of the University of Moscow, chief editor of the *Soviet Encyclopedia*, and director of the Soviet State Publishing House; 7 Sept.

H. KIRK STEPHENSON, Chevy Chase, Md.; 43; program director for Earth Sciences at the National Science Foundation; 2 Sept.

BALDWIN M. WOODS, Berkeley, Calif.; 68; retired vice president of the University of California and former chairman of the department of mechanical engineering; 7 Sept.

HELEN YARNELL, New York, N.Y.; 52; former senior psychologist at the Bronx center of the city Board of Education's Bureau of Child Guidance; 8 Sept.

Education

■ Dedication ceremonies for the University of Florida's Medical Sciences Building, first unit of the J. Hillis Miller Health Center, have been scheduled for 12 and 13 Oct. The program will include addresses by Detlev Bronk of the Rockefeller Institute for Medical Research and Wendell Stanley, head of the University of California's Virus Laboratory.

The University of Florida's first class in medicine was admitted this fall and began classes in the new building. The College of Nursing was also opened for the first time, although headquarters for the college will be the Teaching Hospital, now under construction.

■ The State University of New York College of Medicine in Brooklyn is being transformed into a modern medical center. Highlights of the opening of its 96th academic year this fall are a new $14.5-million Basic Sciences Building, a revised

curriculum for 600 medical students, and inauguration of a graduate educational program.

Begun in 1953, the Basic Sciences Building is the first permanent structure on the site of the State University Downstate Medical Center. It will house administrative offices for the Medical Center and its units (at present, the College of Medicine and the Graduate Educational Program), offices and laboratories for full-time faculty members, instructional facilities for students, and dining and recreational rooms for faculty, students, and staff.

The move to its new site at 450 Clarkson Avenue from the several buildings formerly occupied on Henry Street in the Brooklyn Heights area, places the Downstate Medical Center directly across the street from the city-owned Kings County Hospital Center, which serves as the major facility for the teaching of practical bedside and outpatient medicine to third- and fourth-year medical students. The new building, which is 11 stories high in its central portion and seven stories high at each end, extends for three blocks along Clarkson Avenue.

Under the new curricular plan for medical students, the course will move chronologically from study of the cell to organs, organ systems, the integrated human being, and man in his environmental relationships to provide a more logical united body of knowledge than under the traditional medical program. In addition, the revised course will provide more individualized training for each student. Teaching in smaller groups and an increase in free time will allow a two-level teaching program that will give the slower student more time for study and the faster one more time to pursue elective programs or research.

The Graduate Educational Program in the biological sciences basic to medicine, which is being inaugurated this year, will lead to the Ph.D. degree in anatomy, biochemistry, physiology, and pharmacology. Graduate courses will be taught by faculty members of the College of Medicine who are specialists in the basic science fields covered. Students cannot be enrolled in the medical and graduate programs at the same time.

■ The regents of the University of California have voted on gradual expansion of the faculty and facilities of the La Jolla campus in order to provide a graduate program that will emphasize science and technology.

■ The first in a series of grants in support of computation centers and research in numerical analysis have been announced by the National Science Foundation. Grants totaling $135,500 have been awarded as follows: California Institute of Technology, $38,000; Massachusetts Institute of Technology, $30,000; Oregon State College, $20,000; University of Washington, $17,500; University of Wisconsin, $30,000.

The funds will be variously used—to establish the nucleus for a computing center where none exists, to extend existing centers, and to pay rental for computing time. In some instances part of the funds will be used for salaries of research assistants.

The foundation's program is designed to strengthen basic research in a number of fields by providing research investigators access to computing facilities. Only a few large computing centers are available for basic research problems, and these generally on a part-time basis only. Most computers are busy on a round-the-clock schedule on industrial problems related to defense contracts. The general-purpose university computing laboratory does not have sources of support for basic research at present. Foundation assistance will help to establish or strengthen such general-purpose research laboratories.

■ A graduate program in biology leading to the M.A. and Ph.D. degrees is being inaugurated at Brandeis University, Waltham, Mass., this fall. The faculty of this new department, which is now in process of formation, includes, at present, Harold P. Klein, chairman, Herman T. Epstein, Albert Kelner, Margaret Lieb, Albert G. Olsen, Lionel Jaffe, and Philip St. John. Emphasis in the program will be placed on experimental biology, particularly in the fields of cellular development and differentiation, genetics, microbiology, and physiology.

■ The Atomic Energy Commission has accepted the enrollment of 63 scientists and engineers, 50 of them from 24 foreign nations, for graduate studies in the commission's International School of Nuclear Science and Engineering. The school, operated for the AEC by the Argonne National Laboratory (near Chicago) in cooperation with North Carolina State College and Pennsylvania State University, was launched in 1955. It is providing intensive unclassified studies in reactor technology and related subjects pending the establishment of adequate training facilities in regular educational institutions here and abroad.

After a week of general orientation in Washington, D.C., under the auspices of the International Cooperation Administration, which provides financial support for most of the foreign enrollees, the students were divided into two groups that reported, respectively, to Raleigh, N.C., and State College, Pa., for the first 17 weeks of study.

Meanwhile, the third session students who have completed their work at these two universities have moved on to Argonne, where they will be graduated on 11 Jan. 1957. The fourth session students then will take their places at Argonne. This arrangement, inaugurated with the third session, makes it possible to double the annual total of students that can be accepted for training.

■ A school of dentistry opened this month at Fairleigh Dickinson University, Teaneck, N.J., when 46 students began their first classes. Walter Wilson is dean of the school, which has a faculty of 15.

Grants, Fellowships, and Awards

■ Applications are invited for the $1600 postdoctoral fellowship of Sigma Delta Epsilon, graduate women's scientific organization. Candidates must have the equivalent of a Ph.D. degree and must be conducting research in the mathematical, physical, or biological sciences.

During the term of her appointment an appointee must devote the major part of her time to the approved research project and not engage in other work for remuneration (unless such work shall have received the written approval of the board before the award of the fellowship). Application blanks may be obtained from Dr. Dorothy Quiggle, Petroleum Refining Laboratory, Pennsylvania State University, University Park, Pa.

■ Nominations for the 1957 Eli Lilly research award in bacteriology and immunology are invited. These should be sent *before 15 Jan. 1957* to Dr. Alan W. Bernheimer, New York University College of Medicine, New York 16, N.Y., chairman of the Lilly award nominating committee.

No reprints or manuscripts should be offered. Four copies of all material should be submitted and must include the following: month, day, and year of birth; curriculum; list of publications; specific reference to the research on which the nomination is based; and supporting letters, if possible.

To be eligible a nominee must be less than 35 years of age on 30 Apr. 1957. For the purpose of this award, outstanding research is understood to be that which is of unusual merit in the younger age group. The research is not to be judged in comparison with the work of more mature and experienced workers.

■ The Lipotropic Research Foundation of New York will receive applications for grants-in-aid for 1957 *until 1 Nov.*, with special attention being given to clinical studies. A request for application forms, which should include a short statement describing professional affiliations

and experience, may be addressed to the administrative secretary, Dr. L. Lipton, 26 Vark St., Yonkers 1, N.Y.

■ The Sister Elizabeth Kenny Foundation has announced a program of postdoctoral scholarships for scientists at or near the end of their fellowship training in either basic or clinical fields broadly concerned with the neuromuscular diseases. The Kenny Foundation scholars will be appointed annually. Each grant will provide a stipend for a 5-year period at a rate of between $5000 and $7000 a year, depending upon the scholar's qualifications. Candidates from medical schools in the United States and Canada will be eligible. Inquiries regarding details of the program should be addressed to Dr. E. J. Huenekens, Medical Director, Sister Elizabeth Kenny Foundation, 2400 Foshay Tower, Minneapolis 2, Minn.

In the Laboratories

■ A $150,000 industrial toxicology laboratory has been completed by Industrial Bio-Test Laboratories, Inc., in Northbrook, Ill., a Chicago suburb. The new plant provides facilities for the evaluation of the physiological and toxicological properties of chemicals on all forms of living organisms.

Spacious animal quarters to accommodate both small and large experimental animals have been provided, and a separate section is fitted with balanced aquaria to aid in the study of the effects of water pollution on fish and other marine life. In addition, there are laboratories for radioisotope studies and chemical research, for inhalation studies and air pollution work, and for bacteriological investigations. A greenhouse for the study of agricultural chemicals and residues will be added this fall.

■ The Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced the establishment of a department of radiation research under the direction of Robert H. Schuler, until recently a member of the staff of Brookhaven National Laboratory. The new department will have available a 3-million-volt Van de Graaff accelerator, laboratories for radiochemical and allied work, general laboratories, office space, a radiation library, and equipment for using radioactive cobalt and other radiation sources.

The Van de Graaff accelerator, capable of accelerating either positive or negative ions, will serve as the initial radiation source. This machine, now on order from the High Voltage Engineering Corporation, Cambridge, Mass., will be installed by July 1957. In the meantime an existing accelerator of this type that is in the Pittsburgh area is available for the use of the department.

The department of radiation research is the sixth department to be established by the institute to aid its various fellowships (comprehensive research programs sponsored by industrial companies or associations). Following the usual pattern of operation, the new department will be available to any institute fellowship sponsor requiring its services. It is expected that several new fellowships will be commenced, with specific orientation toward radiation as a processing tool.

■ Some 400 people in Lockheed's Missile Systems Division have moved from the division's plant in Van Nuys, Calif., to new research laboratories in Palo Alto. Those transferring include a number of engineering, administrative, and service employees as well as the scientific and technical staffs. Later transfers will bring the total number in the $4-million laboratories to 600 by mid-October.

Activation of the laboratories, located on a 22-acre site in Stanford University's industrial park, marks the completion of the first phase of the company's $20-million Bay area building program. The new facilities include the two laboratories that have just opened and a third building for additional laboratories and offices that is not yet finished.

In addition, an $8-million plant is now well along in construction on a 275-acre site adjacent to Moffett Field in Sunnyvale. This facility, to be occupied by the summer of 1957, includes manufacturing and engineering units and an administrative building.

Miscellaneous

■ The range and growth of scientific research activities by Federal departments and agencies in carrying out their public responsibilities is indicated in *Organization of the Federal Government for Scientific Activities*, a report that has been released by the National Science Foundation. This is the first comprehensive account of Federal organization for scientific activities since the study undertaken by the President's Scientific Research Board in 1947.

Since that date, Government scientific activities have evolved from isolated, small-scale and loosely knit programs located in a few bureaus to large-scale and highly organized programs spread through virtually all the cabinet departments and major independent operating agencies of the Government. These agencies spend more than $2 billion a year and directly employ more than 130,000 scientists.

Another development is the increased involvement of industry and the universities in scientific research and development of importance to the Government through grants and contracts. A new type of institution has come into being—the Government-financed research center managed by an industrial firm or an educational institution.

Thirty-eight Government agencies are engaged in the conduct of, and support of, basic, applied, and developmental research as well as scientific data collection in the physical, life, and social sciences. The report presents information and organization charts for each of these 38 agencies and their principal bureaus, offices, or other major subdivisions. Copies of *Organization of the Federal Government for Scientific Activities* may be purchased for $1.75 from the Superintendent of Documents, Government Printing Office, Washington, D.C.

■ The William Rowan collection of vertebrate museum material has been purchased by the University of Alberta. The collection, which represents a lifetime of research by Dr. Rowan, founder of the university's department of zoology, will be used for teaching and research purposes. The collection contains a series of complete skeletons and skulls of the extinct wood bison of northern Alberta and the northwest territories. There are also specimens of the plains bison, including the only skull of a European bison ever found in Canada.

■ The Manhattan Society for Mental Health, New York, has announced that it has available a new directory listing every major mental health resource in the United States and its territories. It can be ordered through the society's offices at 40 E. 40 St.

On the list are 1200 full-time and part-time psychiatric clinics. They are listed geographically, with details on sponsorship, area of service, special groups served, clinic schedules, number and type of professional staffs and age limitations on patients. The publication also names other mental health services, including hospitals, state departments dealing with mental health, and 500 state and local mental health associations. The directory was published by the National Association for Mental Health.

■ The U.S. Civil Service Commission has announced an examination for radio engineer for filling positions in the Federal Communications Commission in Washington, D.C., and throughout the United States, its territories, and possessions. The entrance salaries are $4480 and $5335 a year. Further information and application forms may be obtained at many post offices throughout the country, or from the United States Civil Service Commission, Washington 25, D.C.

Reports

Subjective Evaluation and Reinforcing Effect of a Verbal Stimulus

Greenspoon (*1*) has recently shown that when subjects are instructed to "say all the words you can think of," the interposition of "Mm-hmm" by the experimenter following a particular class of responses, such as plural nouns, significantly increases the production of these responses over successive periods. He also suggests that the subjects are not aware of the contingency between their behavior and that of the experimenter. While such learning without awareness is not new in the psychological literature, the effect of such an innocuous phrase as a reinforcer has attracted particular attention.

The data reported here, which are abstracted from a larger study of subjects' reactions to reinforcing stimuli, report on a relationship between free-responding verbal behavior, the reinforcing effect of a verbal stimulus, and the subjects' evaluation of that stimulus (*2*).

A total of 28 male summer-school students were used as subjects in the verbal reinforcement experiment. They were tested individually in a small experimental room, with the experimenter seated behind the subject. Each subject was informed that this was a test of the "total available vocabulary of college students." He was requested to say all words that he could think of, not to repeat words, not to count or to give phrases or sentences. All responses were recorded on tape. In the reinforcement period, the experimenter emitted the reinforcing interjection "Mm-hmm" immediately after every plural-noun response. All subjects gave 500 responses before they were stopped. The first 100 responses were used to obtain the operant level of plural-noun responses, and no responses were reinforced. During the next 200 responses, all plural nouns were followed by the reinforcing stimulus. During the last 200 responses, no reinforcements were given in order to obtain extinction data.

After the response session, all subjects were given an extended interview to determine the subjects' reactions to the reinforcing situation (*3*). This interview consisted of 30 open-ended questions which began with a general "What did you think about during the experiment?" and led to specific questions whether the subject was aware of the contingency between his production of plural nouns and the behavior of the experimenter.

The responses of all subjects to the interview were scored on a scale of 1 to 11, with a score of 1 representing full awareness of the reinforcing contingency and 11 representing a complete lack of awareness. Full awareness was defined as a description by the subject of the contingency between the plural noun response and the experimenter's behavior, while complete unawareness required that the subject verbalize no hypothesis concerning this contingency. The obtained awareness values ranged from 3 to 11 with a mean of 5.9, and a rater reliability of 76 percent. The mean rating of 6 indicates that the average subject verbalized some secondary hypothesis that there might have been some unknown relationship between his associations and the experimenter's behavior. None of the subjects, however, was able to state specifically what the contingency was.

All subjects were aware of the fact that the experimenter did say "Mm-hmm" every now and then. In the course of the interview they were asked what they thought this behavior indicated. On the basis of this question they were divided into two groups, a positive and negative group. The positive group consisted of those subjects who thought that the reinforcer had positive aspects, that it meant they were doing all right, that it was encouraging them to go on. The negative group thought that the reinforcer had negative aspects, that it meant they were going too fast, giving the wrong kinds of words. Many of these subjects would stop after the first occurrence of the reinforcer as if they were expecting further instructions. The mean awareness values for these two groups were 6.4 for the positive group and 5.6 for the negative group, showing no significant difference between the two groups on this variable.

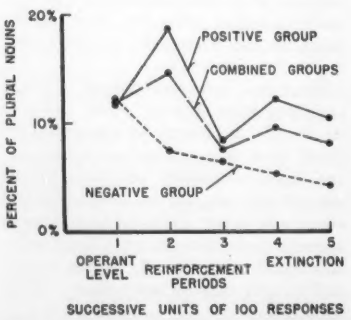


Fig. 1. Relative production of plural nouns during successive response periods.

Figure 1 shows the effect of the reinforcer on the production of plural nouns. The dependent measure used was the percentage of plural nouns out of total nouns given in any 100-word period. This relative index of plural-noun production was used because the production of all nouns (singular and plural) was affected by the reinforcing stimulus. Figure 1 shows little effect of the reinforcer on the relative production of plural nouns when all subjects are combined. While there is a slight increase in the first reinforcing period, this increase is not significant. When the positive and negative subjects are separated, however, there is a clear difference between the two groups. The positive group shows a significant increase in plural-noun production during the first reinforcing period ($p < 0.05$), while the negative group shows a decrease. The difference between the two groups in the first reinforcing period is, of course, significant ($p < 0.01$). In the subsequent periods, however, no such difference appears. The positive group returns to below operant level in the second reinforcing period and changes little from then on, while the negative group continues to decrease.

The effect in the initial reinforcing period shows a clear relationship between the subjects' evaluation of the reinforcing stimulus and the effect of that stimulus on their verbal behavior. A positively evaluated stimulus operates as a positive reinforcer, while the same stimulus has a negative reinforcing effect if the subject evaluates it as a negative stimulus. Since there are no differences in the awareness of the subjects in the two groups, this effect cannot be simply ascribed to some cognitive response to the contingency in one group which is absent in the other. It is also difficult to ascribe the difference between the two groups to some simple mediating judgment. None of the subjects said that, because the reinforcer was encouraging or discouraging, he reacted or decided to react by increasing or decreasing the particular association or response that preceded it. Some such mediating process may of course have taken place during the experiment. If it did, the subjects could not recall it by the end of the session.

The results of this study indicate that, in human verbal learning, the subjects'

subjective evaluation of the reinforcing stimulus may provide an independent measure of the reinforcing value of a verbal reinforcer.

GEORGE MANDLER
WARREN K. KAPLAN
Department of Social Relations, Harvard University, Cambridge, Massachusetts

References and Notes

1. J. Greenspoon, *Am. J. Psychol.* 68, 409 (1955).
2. This study was supported by an undergraduate research grant from the Social Science Research Council and by a grant from the Center for International Studies, Massachusetts Institute of Technology.
3. We would like to thank Sherman Tatz for the use of the questionnaire which he developed for a similar study.

8 August 1956

Influence of "Aging" on the Characteristics of an Electrodeless Discharge

"Aging" of a freshly prepared discharge tube—that is, maintaining the discharge for a period of time—at a constant applied potential V, has been found to affect the discharge characteristics markedly. The influence of aging on the conductivity of a low-frequency electrodeless discharge in iodine vapor is reported here. The details of the experimental set up are similar to those reported earlier by Saxena and me (*2*).

Aging decreases the discharge current i and the "threshold potential" V_m, namely, the potential at which the discharge becomes self-maintained. The conductivity decreases (i) very rapidly during the first few minutes, (ii) less rapidly during the next few minutes, and (iii) slowly until it attains saturation. Figure 1 shows a typical plot of the discharge current i versus time t in minutes. The equation proposed by Saxena *et al.* (*3*) ($\delta i = kt^{1/m}$) for similar observations in water vapor and iodine vapor under ozonizer discharge seems to hold good only during the afore-mentioned period (ii).

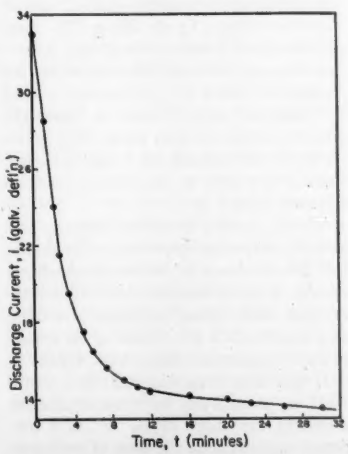


Fig. 1. Variation of discharge current with time.

The decrease of the threshold potential on aging was observed even in the presence of excess of solid iodine and therefore cannot be ascribed to the pressure drop caused by adsorption of the vapor on the walls of the vessel. Aging reduces the width of the period of the discharge which is not self-maintained. In a particular experiment, the potential in the period that was not self-maintained was between 0.79 and 1.33 kv before aging, while it was between 0.79 and 1.06 kv after aging. Furthermore, aging is effective only when it is carried out at $V > V_m$; aging at $V < V_m$ has no appreciable effect on the discharge characteristics.

C. N. RAMACHANDRA RAO
Department of Chemistry, Purdue University, West Lafayette, Indiana

References and Notes

1. The work described was undertaken in the physicochemical laboratories of the Benares Hindu University, Benares, India. My thanks are due to S. S. Joshi for his kind interest in the work.
2. A. P. Saxena and C. N. Ramachandra Rao, *J. Sci. Research, Agra Univ.* 3, 207 (1954.)
3. A. P. Saxena, M. G. Bhatawdekar, N. A. Ramaiah, *Nature* 171, 929 (1953).

1 August 1956

Preparation of Pure Hydroxyapatite Crystals

Naturally occurring hydroxyapatite exhibits a variable composition and contains impurities that have unknown effects on the structure and properties of the basic compound. A simple method for the production of pure, well-crystallized hydroxyapatite has long been needed. Methods of synthesis for this mineral have been reported in the past (*1*), but all of them produced impure and poorly crystallized products. This communication describes the preparation of pure hydroxyapatite suitable for x-ray diffraction, single-crystal studies.

The procedure is similar to an early preparation of hydroxyapatite by the hydrolysis of brushite ($CaHPO_4 \cdot 2H_2O$) (*2*). In the method outlined here, monetite ($CaHPO_4$), instead of brushite, is hydrolyzed to hydroxyapatite in a closed system. The reaction involved is probably one, or both, of the following.

$$10CaHPO_4 + 2H_2O \xrightarrow{300°C} Ca_{10}(PO_4)_6(OH)_2 + 4H^+ + 4H_2PO_4^- \quad (1)$$

$$14CaHPO_4 + 2H_2O \xrightarrow{300°C} Ca_{10}(PO_4)_6(OH)_2 + 4Ca^{++} + 8H_2PO_4^- \quad (2)$$

An orthophosphoric acid solution (1 vol of reagent-grade 85-percent H_3PO_4 to 5 vol of distilled water) was saturated at room temperature with reagent-grade tribasic calcium phosphate. Well-crystallized $CaHPO_4$ was precipitated from the clear saturated solution by heating the solution nearly to its boiling temperature. The $CaHPO_4$ was filtered from the hot solution, washed thoroughly with distilled water, rinsed with absolute alcohol, and finally dried at 105°C. From 0.5 to 1.0 g of $CaHPO_4$ may be obtained from 100 to 150 ml of the saturated solution.

Pure well-crystallized $Ca_{10}(PO_4)_6(OH)_2$ was prepared from the reaction of 0.1 g of the $CaHPO_4$ with 10 ml of distilled water in a platinum-lined, Morey-Ingerson type hydrothermal bomb (*3*) at 300°C for 10 days. During this time, the system had an internal pressure of about 1250 lb/in.^{2} owing to the vapor pressure of saturated steam at 300°C.

To obtain a complete reaction, it was necessary to use at least 10 ml of water for each 0.10 g of $CaHPO_4$. Less than this ratio of water to $CaHPO_4$ resulted in a mixed product of $Ca_{10}(PO_4)_6(OH)_2$ and $CaHPO_4$. Apparently the controlling factor for the hydrolysis is the final pH of the liquid. As long as this pH stays above 2.0 to 2.5, the reaction will proceed in the desired direction. Below a pH of about 2.0, the stable solid phase is $CaHPO_4$ for the reaction conditions used.

The presence of certain cation impurities can strongly influence the final product. During some preparations, the platinum lining developed cracks and Fe and Cr ions from the steel bomb were introduced into the water. When this happened, the final product contained a large proportion of well-crystallized whitlockite [β-$Ca_3(PO_4)_2$].

Under normal conditions, well-developed clear hexagonal dipyramidal crystals of hydroxyapatite, which range up to about 0.3 mm in length, are produced. A spectrographic analysis showed the following amounts of impurities: 0.01–0.1 percent = Cu, Fe, Na, Pb, Si, Sr; 0.001–0.01 percent = Al, Ba, Cr, Mg, Ni, Pt; 0.0001–0.001 percent = Ag, Mn.

A petrographic examination showed the crystals to be uniaxial negative with indices of refraction: $\varepsilon = 1.643 \pm 0.002$ and $\omega = 1.649 \pm 0.002$.

A method has been reported by Hayek, Lechtleitner, and Böhler (*4*) for obtaining well-crystallized hydroxyapatite by heating a finely divided hydroxyapatite with NaOH solution in a hydrothermal bomb. Although these investigators obtained well-formed crystals, the product was not as pure as might be desired, for these crystals contained at least 0.5 percent Na (*5*). Also, no attempt to remove the carbonate ion was made by Hayek and coworkers, and the influence of car-

bonate in apatite is still a much disputed question.

In conclusion, using the method presented in this report, it is possible to obtain a pure well-crystallized hydroxyapatite, with negligible quantities of extraneous ions in the crystals. The major disadvantage of the method is the small crop obtained from each hydrolysis because of the small capacity of the bombs used. Larger reaction vessels would minimize this objection.

ALVIN PERLOFF
U.S. Army, National Bureau of Standards, Washington, D.C.
AARON S. POSNER
American Dental Association Research Fellowship, National Bureau of Standards, Washington, D.C.

References

1. E. B. Jaffe, *Geol. Survey Circ. No. 135*, Washington, D.C. (1951).
2. A. Schleede, W. Schmidt, H. Kindt, *Z. Elektrochem.* 38, 633 (1932).
3. G. W. Morey and E. Ingerson, *Am. Mineralogist* 22, 1121 (1937).
4. E. Hayek, J. Lechtleitner, W. Böhler, *Angew. Chem.* 67, 326 (1955).
5. E. Hayek, Private communication.

16 July 1956

Beryllium-10 Produced by Cosmic Rays

The bombardment of the nitrogen and oxygen of the atmosphere by cosmic rays can produce four nuclides of useful life. Three of these, carbon-14, tritium, and beryllium-7, have been identified and used for studies of time scales of natural processes (*1*). This paper (*2*) reports the isolation and identification of the fourth, beryllium-10, a β^- emitter of half-life 2.5×10^6 years (*3*).

The amount of Be^{10} produced should be very small. Peters (*4*) predicts a production rate—equivalent in steady state to the decay rate—of 0.05 to 0.1/cm² sec. My own prediction is about 0.04/cm² sec, with a large uncertainty.

Beryllium-10 should have the same early history as Be^7, which is removed from the atmosphere chiefly by rain. That portion which falls on the ocean may or may not enter into true solution there, but, in any case, it should find its way into the bottom sediments. We have been led, therefore, to examine the deep-sea bottom sediments for Be^{10}. In particular, we have studied "red clay" sediments, which show the lowest sedimentation rates and thus probably the highest relative concentrations of Be^{10}.

Samples from two cores taken from the eastern Pacific have now been analyzed for Be^{10}. These cores were obtained by E. D. Goldberg of the Scripps Institution of Oceanography at approximately latitude 28°N, longitude 125°W at a depth of 2200 m. The cores were approximately 5 cm in diameter, with a total length of 120 cm. Each was divided into five sections, which were analyzed for Be^{10}.

The chemical problem of isolating milligram amounts of beryllium from hundreds of grams of clay proved quite difficult. The chemistry used in core G resulted in erratic yields. An improved procedure was used on core H, a brief account of which follows. The sample (wet clay) is treated with a mixture of 500 g of 48-percent HF and 500 g of 12*N* HCl in two 1-lit HH polythene beakers, after 10 ml of Be carrier (5.9 mg of BeO per milliliter) has been added. After the sample has been evaporated to dryness in a hot-air jet, 150 g of each acid is added, and the sample is again evaporated to dryness. Two further evaporations with 500 g of HCl serve to remove most of the fluoride. The sample is taken up in 1500 ml of 1*N* HCl, boiled, decanted, and centrifuged. The remaining solid is heated with H_2SO_4 until HF bubbles cease. The cake is taken up with water, the small amount of remaining solid being fused with $KHSO_4$. The final solid is discarded, and all solutions are combined. The precipitate is discarded.

Six hundred fifty grams of Versene (the commercial tetrasodium salt of EDTA) is added, and the solution is brought to *p*H 6 to 6.5. Twenty-five milliliters of 2,4-pentanedione is added, and after the solution has stood for 5 minutes, it is extracted with three 250-ml portions of reagent-grade benzene. These are combined and backwashed with acetate-buffered water at *p*H 5.5 to 6.

Table 1. Beryllium-10 activity of core samples.

Sample	Depth in core (cm)	Chemical yield (%)	Observed count (count/min)	Activity per cm³ of clay (disintegration/min)
G-2	25–50	37	0.310 ± 0.020	$(7.6 \pm 0.5) \times 10^{-5}$
G-4	75–100	36	0.184 ± 0.023	$(4.5 \pm 0.6) \times 10^{-5}$
H-1	0–25	34	0.257 ± 0.037	$(7.1 \pm 1.0) \times 10^{-5}$
H-2	25–50	56	0.228 ± 0.040	$(4.4 \pm 0.8) \times 10^{-5}$
H-3	50–75	9	0.063 ± 0.037	$(6 \pm 3) \times 10^{-5}$
H-4	75–100	35	0.143 ± 0.049	$(3.8 \pm 1.3) \times 10^{-5}$
H-5	100–117	41	0.142 ± 0.036	$(4.9 \pm 1.3) \times 10^{-5}$

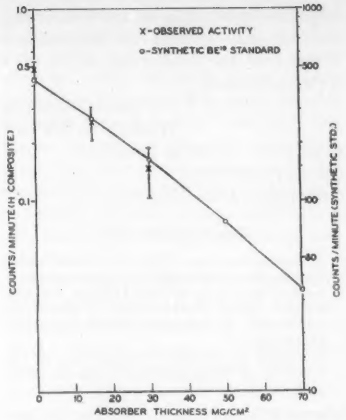


Fig. 1. Absorption curves of observed activity and of synthetic Be^{10} standard in polyethylene in close cylindrical geometry.

The benzene layer is then extracted with two 150-ml portions of 6*N* HCl. Forty-five grams of disodium Versenate is added, and the HCl solution is brought to *p*H 6 to 6.5. Ten milliliters of 2,4-pentanedione is added, and, after the solution has stood, it is extracted with three 75-ml portions of benzene. The latter are combined, backwashed, and finally extracted with two 50-ml portions of 6*N* HCl. The acid solution is boiled down nearly to dryness, HNO_3 being added to destroy organic matter. Finally, 50 ml of water is added, the solution is made basic with ammonia, and the precipitate is filtered and ignited to BeO. This procedure seems to be entirely specific for beryllium. The reactions involved are discussed in the literature (*5*).

The samples were counted as BeO in close cylindrical geometry on two small thin-walled counters (*6*) inside rings of Geiger tubes in anticoincidence. The background was 0.25 to 0.5 count/min for a counter 6 cm long and 1.5 cm in diameter using a Q gas filling. The samples were not infinitely thin, and correction was made for self-absorption by the method of Libby (*7*), for geometry, and for chemical yield, in order to obtain the absolute disintegration rates. The activities are normalized to 1 cm³ of clay, since this seems to be a more definite quantity than 1 g.

The results are shown in Table 1. The activity decreases somewhat with depth, but this tendency is neither marked nor regular. Core H was noted to be inhomogeneous with strong evidence of sorting at a depth of 35 cm. There is no reason to expect a regular decay with depth.

If the sedimentation rate is 1 mm/1000 yr, these cores have an equivalent depth of the order of 10^6 yr. Our evidence suggests that the rate of sedimentation in our cores is not slower than this by a large factor. If we use this figure,

averaging all results from both cores, we obtain an estimate of 0.03 disintegration/sec cm² contained in the sediment column. This is of the expected order of magnitude. No more can be said at present. Even this is not without interest from the point of view of the constancy of the cosmic-ray flux.

In addition to the data given here, other measurements were made to identify the observed activity. Samples G-2 and G-4 were combined, and a second complete cycle of purification was carried through. The original samples contained 0.92 ± 0.06 disintegration/min (assuming that the self-absorption correction of Be^{10} applies). The recycled sample showed 0.68 ± 0.20 disintegration/min after correction for chemical yield. Seven months elapsed between the two measurements.

An absorption curve was run on a composite sample of H-1, H-2, H-4, and H-5, using polyethylene absorbers. The data are plotted in Fig. 1. A curve for a synthetic sample of Be^{10} under the same conditions is shown for comparison. The absorption curve in close cylindrical geometry approaches an exponential (7). The half-thickness of the natural sample is 17 ± 4 mg/cm², while that of the synthetic sample is 21.2 ± 0.3 mg/cm² in the same region of the absorption curve. Using Libby's relation for half-thickness versus energy and mass number (8), we obtain $E = 0.52 \pm 0.08$ Mev, compared with 0.56 Mev for the known activity. A further check on the half-thickness is the self-absorption correction of the composite sample. The count rate of the composite sample was 0.65 ± 0.07 times the sum of the original samples, while the calculated value is 0.76. No gamma activity was found in any sample.

One set of data has been discarded—that obtained in my effort in Chicago to measure the absorption curve of the original G composite. The data indicate strongly that absorbers or other materials were contaminated.

Our intention is to use Be^{10} if possible for radioactive age determination. Much work on the geochemistry of beryllium still must be done before this method can be safely used.

A final word should be said on measurement techniques. A counting method appears to be the most practical at the present time, although Peters (4) has suggested a photographic-plate technique. It is worth noting that, if the beryllium content of sediments is of the order of 1 ppm, the Be^{10}/Be^{9} ratio is about 10^{-7}. This does not seem to be permanently outside the range of solid-source mass spectrometry, although the difficulties would be extreme.

JAMES R. ARNOLD
Department of Chemistry,
Princeton University,
Princeton, New Jersey

References and Notes

1. W. F. Libby, *Phys. Rev.* 69, 671 (1946); W. F. Libby, *Radiocarbon Dating* (Univ. of Chicago Press, Chicago, Ill., ed. 2, 1955); H. v. Buttlar and W. F. Libby, *J. Inorg. Nuclear Chem.* 1, 75 (1955); J. R. Arnold and H. A. Al-Salih, *Science* 121, 451 (1955).
2. I am indebted to many persons for assistance in this work. The cores were supplied by E. D. Goldberg. H. A. Al-Salih carried out the chemical extractions in the G series. E. F. X. Lyden assisted with those of the H series. T. T. Sugihara and E. A. Martell kindly made available their counting equipment and assisted in the counting. C. S. Wu kindly supplied the synthetic Be^{10} sample. The work was supported by a contract with the Office of Ordnance Research, U.S. Army.
3. E. M. McMillan, *Phys. Rev.* 72, 591 (1947).
4. B. Peters, *Proc. Indian Acad. Sci.* A41, 67 (1955).
5. R. Pribil, *Collection Czechoslov. Chem. Communs.* 16, 86 (1951); J. A. Adam, E. Booth, J. D. H. Strickland, *Anal. Chim. Acta* 6, 462 (1952); I am indebted to I. Russell for an unpublished procedure.
6. T. T. Sugihara, R. L. Wolfgang, W. F. Libby, *Rev. Sci. Instr.* 24, 511 (1953).
7. A. D. Suttle, Jr. and W. F. Libby, *Anal. Chem.* 27, 921 (1955).
8. W. F. Libby, *Anal. Chem.*, in press.

29 June 1956

Quantum Yields of Fluorescence of Plant Pigments

The fate of excitation energy in photosynthesis requires elucidation. Toward this end, we have determined the quantum yields of fluorescence of several photosynthetic pigments, *in vitro* and *in vivo* (1). The measurements were made with a specially constructed integrating sphere (2). The main results are shown in Tables 1 and 2.

Our values of the quantum yields of fluorescence ϕ of chlorophylls *a* and *b* are about 40 percent higher than those reported by Forster (3). We believe that this difference is the result of a more accurate determination in our experiments of the detector sensitivity as a function of wavelength, and a more reliable "sampling" of the incident light and fluorescence with the sphere. Both the ratio of the fluorescence yield of chlorophyll *b* to that of chlorophyll *a* and the strong effect of solvent on the former, reported by Forster, are confirmed.

As was anticipated by Duysens (4), ϕ of chlorophyll *in vivo* was found to be an order of magnitude higher than the value previously accepted on the basis of the measurements of Wassink *et al.* (5). The new data indicate that the actual lifetime of excitation of the first excited singlet state of chlorophyll *a in vivo* is of the order of 10^{-10} second, rather than 10^{-11} second, as has been previously assumed. This offers a correspondingly better chance for migration of excitation energy between chlorophyll molecules.

The quantum yield of chlorophyll fluorescence *in vivo* was previously known to change (usually to increase but sometimes to decrease) with increasing intensity of the exciting light at photosynthesis-saturating intensities (6). We found this yield to vary also with the exciting intensity when the latter was as low as 0.01 of that required for the compensation of respiration by photosynthesis (see Fig. 1). Recent measurements by Brugger (7) are consistent with the results shown in Fig. 1.

Franck's theory of "narcotization" of the chlorophyll complex, which could explain the intensity dependence of ϕ at

Table 1. Quantum yields of fluorescence of pigments in solution.

Pigment and solvent	Wavelength of exciting light (mμ)	Quantum yield of fluorescence* (ϕ)
Chlorophyll *a*		
Ethyl ether	430	0.33
Methanol	436	0.32
Pyridine	436	0.35
Ethyl chlorophyllide *a*		
Ethyl ether	436	0.33
Chlorophyll *b*		
Ethyl ether	436	0.16
Methanol	436	0.034
Phycocyanin (from *Synechocystis* sp.)		
Water (0.1*M* phosphate buffer, *p*H 6.2)	546	0.53
Phycoerythrin (from *Porphyridium cruentum*)		
Water (0.1*M* phosphate buffer, *p*H 6.2)	480	0.85
Fluorescein		
Aqueous NaOH	436	0.91

* Corrected for self-absorption of fluorescence by extrapolation to zero concentration.

Table 2. Quantum yields of fluorescence of pigments in the living cell.

Pigment and organism	Wavelength of exciting light (mμ)	Quantum yield of fluorescence* (ϕ)
Chlorophyll *a*		
Chlorella pyrenoidosa (green alga)	436	0.027†
	436	0.017–0.020‡
Navicula minima (diatom)	436	0.028†
Synechocystis sp. (blue-green alga)	436	~0.015†
Phycocyanin *Synechocystis* sp.	546	~0.030–0.035

* Corrected for self-absorption of fluorescence by extrapolation to zero concentration.
† Excited with 50 erg/cm² sec.
‡ Extrapolated to very low intensities of exciting light.

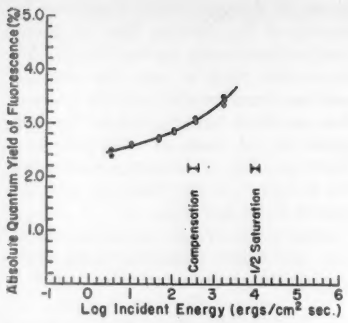


Fig. 1. Quantum yield of fluorescence of *Chlorella* cells. Yield is shown as a function of the logarithm of the intensity of the exciting beam (averaged over its path in the vessel). $\lambda_{ex.} = 436$ mμ. The same values plotted on a linear rather than semilogarithmic scale lead to a curve that is concave downward rather than upward.

photosynthesis-saturating intensities, is not applicable at the low intensities studied here. Apparently, the intensity dependence of ϕ *in vivo* is due to two (or more) factors that come into play in different intensity ranges. The change in ϕ near or below the compensation point may reflect the participation in photosynthesis of respiratory intermediates whose relative importance must decrease as the intensity increases.

We did not observe an inflection in the $\phi = f(I)$ curve corresponding to the one reported by Kok (*8*) for photosynthesis. But kinetic considerations show that, even if different factors govern ϕ primarily in different intensity regions, such inflections would not necessarily occur.

PAUL LATIMER*
T. T. BANNISTER
E. RABINOWITCH

Department of Botany,
University of Illinois, Urbana

References and Notes

1. This work was supported by the Office of Naval Research. We wish to thank Robert Emerson and Ruth V. Chalmers, for growing the algal cells, and A. S. Holt, for providing the chlorophyll.
2. A description of this apparatus is in preparation.
3. L. S. Forster, thesis, University of Minnesota (1951); L. S. Forster and R. Livingston, *J. Chem. Phys.* 20, 1315 (1952).
4. L. M. N. Duysens, thesis, University of Utrecht (1952) p. 82.
5. E. C. Wassink and J. A. H. Kersten, *Enzymologia* 11, 282 (1944); D. Vermeulen, E. C. Wassink, G. H. Reman, *ibid.* 4, 254 (1937).
6. E. Rabinowitch, *Photosynthesis and Related Phenomena* (Interscience, New York, 1951, 1956), vol. 2, pt. 1, pp. 1047–78; pt. 2, p. 1871.
7. J. Brugger, in *Research in Photosynthesis, National Science Foundation* (Interscience, New York, 1956).
8. B. Kok, *Biochem. et Biophys. Acta* 3, 625 (1949).

* Present address: Carnegie Institution of Washington, department of plant biology, Stanford, Calif.

7 August 1956

Sperm Transport in the Reproductive Tract of the Female Rabbit

Previous estimates of the time required for sperm ascent in the reproductive tract of the female rabbit usually have been based on flushing various regions of the tract at definite intervals after mating (*1, 2*). The present note offers another approach to the problem—namely, tubal ligation at various times after mating and the subsequent examination of the trapped eggs for evidence of fertilization. While this work was in progress, a paper using the same technique with several variations appeared (*3*); the results reported here confirm Adams' findings.

Mature New Zealand giant white does were used in the experiments (*4*). The rabbits were bred once to males of proved fertility. At intervals of 0.5, 2, 3, 4, and 5 hours *post coitum*, laparotomies were performed, and the fallopian tubes were doubly ligated and sectioned at the uterotubal junction. The rabbits were killed between 48 and 52 hours *post coitum*, the tubes were flushed with 0.9 percent saline solution, and the recovered eggs were then examined for evidence of normal cleavage and development.

The results indicate that sufficient sperm are in the tubes of every animal by 5 hours *post coitum* to fertilize all viable eggs (Table 1). The increase in the percentage of fertilized eggs between 4 and 5 hours *post coitum* parallels a similar rise in the number of sperm recovered from the tubes during the same time span (*2*). However, it is misleading to account for the increased percentage of fertilized eggs on the basis of an increase in the *mean* number of spermatozoa. The most likely explanation for the increased percentage of fertilized ova is that sperm have reached the tubal level of *every* animal by 5 hours *post coitum*. Before this time, there is considerable individual variation in the rate of sperm entry into the tubes as measured by the number of animals with fertilized ova at different hours *post coitum* (Table 1).

Table 1. Fertilizing ability of rabbit sperm in ligated fallopian tubes. (Eggs examined 48 to 52 hours *post coitum*).

Time *post coitum* tubes ligated (hr)	No. rabbits	No. of follicular rupture points	No. of eggs recovered	Percentage of fertilized eggs	No. of animals with fertilized ova
½	3	21	20	0	0
2	5	48	31	19	1
3	5	54	53	47	3
4	5	29	25	40	3
5	5	46	41	98	5

Differences from animal to animal in uterine motility and in the mechanical barrier offered by the cervix and uterotubal junction probably account for the variability in the rate of sperm transport before 5 hours *post coitum* (*2, 5*).

GILBERT S. GREENWALD*

Department of Embryology,
Carnegie Institution of Washington,
Baltimore, Maryland

References and Notes

1. W. Heape, *Proc. Roy. Soc.* (*London*) *B* 76, 260 (1905); G. H. Parker, *Trans. Roy. Soc.* (*London*) *B* 219, 381 (1931).
2. A. W. H. Braden, *Australian J. Biol. Sci.* 6, 693 (1953).
3. C. E. Adams, *J. Endocrinol.* 13, 296 (1956).
4. This work was performed during the tenure of a U.S. Public Health Service postdoctoral fellowship. I wish to thank William Cleary for his technical assistance.
5. M. C. Chang and G. Pincus, *Physiol. Revs.* 31, 1 (1951).

* Present address: department of anatomy, University of Washington, Seattle.

20 July 1956

Cold-Adapted Genetic Variants of Polio Viruses

Variants of the polio viruses have been obtained through passage in various *in vitro* systems. Enders, Weller, and Robbins (*1*) passaged the Brunhilde strain (antigenic type I) in tissue cultures of human embryonic skin muscle and obtained a variant of reduced virulence for monkeys. Sabin, Hennessen, and Winsser (*2*) have obtained variants of Mahoney (type I), Y-SK (type II), and Leon (type III), which are also relatively avirulent in monkeys, through passage at 1-day intervals with large inocula in tube cultures of cynomolgus monkey kidney cells. Li, Schaeffer, and Nelson (*3*) have combined passages *in vitro* with passages *in vivo* to obtain variants of Mahoney and Leon which show various patterns of virulence for mice and monkeys. Melnick (*4*) has also reported attenuation of polio viruses through serial passages of high concentrations of virus in tissue culture. Dulbecco and Vogt (*5*) have obtained an *r* (rapid) mutant of Brunhilde through serial rapid passage on monolayer cultures of cynomolgus monkey kidney cells. Slow Mahoney (*6*), a genetic variant of Mahoney that produces relatively tiny plaques on monolayers of monkey kidney cells, was isolated after propagation of the parental Mahoney on HeLa cells. In the work reported here (*7*), cold-adapted genetic variants of the polio virus strains Akron (type I), Brooks (type II), and Mabie (type III) have been obtained through passage at 30°C on monkey kidney cells.

Table 1. Comparisons of original polio viruses and cold-adapted derivatives in time required for completion of cytopathogenic action on monkey kidney cells in stationary tubes at 30° and 36°C.

Polio virus strain and pool	Temperature (°C)	Time required for completion of cytopathogenic action (mean day tubes positive)		
		10,000 PPP*	1000 PPP	100 PPP
Original Akron (PP1)	30	6.0	7.4	≧8.2
Cold-adapted Akron (PP3)	30	3.2	4.0	4.4
Original Akron (PP1)	36	3.4	3.8	4.3
Cold-adapted Akron (PP3)	36	3.4	4.5	4.8
Original Brooks (PP1)	30	4.8	4.8	6.0
Cold-adapted Brooks (PP3)	30	3.4	4.2	4.8
Original Brooks (PP1)	36	3.2	3.2	3.6
Cold-adapted Brooks (PP3)	36	3.2	3.6	3.7
Original Mabie (PP1a)	30	4.7	6.1	7.9
Cold-adapted Mabie (PP3)	30	3.2	3.2	4.5
Original Mabie (PP1a)	36	3.2	3.4	3.7
Cold-adapted Mabie (PP3)	36	6.8	8.4	≧10.0

* Plaque-producing particles (PPP) inoculated per tube. All of the determinations were made on the same lot of monkey kidney cells and each entry is the mean of five or six tubes.

Akron plaque-purified pool No. 1 (PP1), Brooks PP1, and Mabie PP1a(*6*) were selected for passage. The cultures of monkey kidney tissue used for passage were cultures of trypsinized rhesus or cynomolgus monkey kidney cells which had grown for 6 days in tubes at 36°C on medium D (*8*). The cultures were washed once with 0.90 ml of medium 199 (*9*) before inoculation. For each passage, 0.10 ml of virus, usually at 10^{-2} concentration, was inoculated into such cultures containing 0.90 ml of medium 199. The tubes were slanted at 30°C, examined daily for cytopathogenic action, and harvested as soon as at least 90 percent of the cells were destroyed. Ten such serial passages were made with each strain. The tenth passage level of each was then purified through plaque isolation three times serially at 30°C. A pool was formed at 30°C in bottles of monkey kidney cells from the third plaque passage of each.

The 30°C-passaged viruses, in comparison with the original viruses, have more rapid cytopathogenic action on monkey kidney cells in tubes at 30°C (Table 1). Furthermore, these cold-adapted variant particles produce larger plaques at 30°C than do their progenitor particles.

Curves that show the propagation of the original viruses and their cold-adapted derivatives on monkey kidney cells at 30° and 36°C have been determined (Fig. 1). Supernatant fluids of tube cultures were harvested daily and assayed by the plaque method of Dulbecco and Vogt (*10*). These curves show that the cold-adapted variants propagate more rapidly at 30°C than do their progenitors.

Plaques formed by the original viruses at 30°C and by the cold-adapted variants at 36°C have been isolated, and the progeny particles in these plaques have been studied with respect to their cold adaptation. In each case, the nature of the progeny particles was a function of the nature of the parental particle and not a function of the environment—that is, the temperature, in which they were formed. Thus these cold-adapted pools are composed, at least predominantly, of polio virus particles that are genetically altered in their capacity to propagate on monkey kidney cells at 30°C.

Whereas all three cold-adapted variants are partially deadapted to propagation at 36°C in monkey kidney tissue cultures (see Table 1 and Fig. 1), the deadaptation of Mabie is much greater than that of Akron or of Brooks. It is possible that these cold-adapted variants may be generally deadapted to propagation at temperatures as high as 36°C and, hence, may possess less virulence for a primate whose body temperature is normally somewhat greater than 36°C. Therefore, these cold-adapted variants have been compared with the original viruses in virulence for rhesus and cynomolgus monkeys by the intraspinal route of inoculation (*11*). The data available at this time show that the cold-adapted variants of Akron and of Brooks do not differ in virulence from their progenitors. The cold-adapted Mabie, however, has been found to be less virulent (*12*) than the original Mabie. Thus, the strain that has been strikingly deadapted to propagation at 36°C in tissue culture is also the one that has become less virulent for the monkey. This result suggests that the degree of loss of ability of 30°C-passaged viruses to propagate at 36°C in tissue cultures may serve as an indicator of the degree of their loss of virulence for a warm-blooded animal.

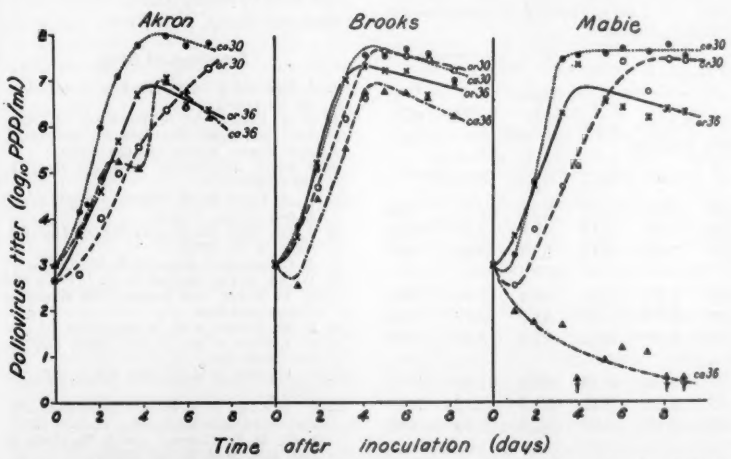


Fig. 1. Propagation curves of original and cold-adapted polio viruses on monkey kidney cells at 30° and 36°C. Original viruses, *or*; cold-adapted derivatives, *ca*. The temperature at which viruses were grown follows the symbol. The arrows indicate that the values recorded are maximal; that is, no virus was found in the aliquots assayed. All harvests of any one of the three strains were made from the same preparation of monkey kidney cells and consisted usually of the pooled fluids from two tube cultures selected at random from many replicate inoculated cultures.

GEORGE R. DUBES
MARGARET CHAPIN

Section of Virus Research, Department of Pediatrics, University of Kansas School of Medicine, Kansas City

References and Notes

1. J. F. Enders, T. H. Weller, F. C. Robbins, *Federation Proc.* 11, 467 (1952).
2. A. B. Sabin, W. A. Hennessen, J. Winsser, *J. Exptl. Med.* 99, 551 (1954).
3. C. P. Li, M. Schaeffer, and D. B. Nelson, *Ann. N.Y. Acad. Sci.* 61, 902 (1955).
4. J. L. Melnick, *Federation Proc.* 13, 505 (1954).
5. R. Dulbecco and M. Vogt, *Ann. N.Y. Acad. Sci.* 61, 790 (1955).
6. G. R. Dubes. *Virology* 2, 284 (1956).

7. Aided by a grant from the National Foundation for Infantile Paralysis.

8. J. S. Youngner, *Proc. Soc. Exptl. Biol. Med.* 85, 202 (1954).

9. J. F. Morgan, H. J. Morton, R. C. Parker, *ibid.* 73, 1 (1950).
10. R. Dulbecco and M. Vogt, *J. Exptl. Med.* 99, 167 (1954).
11. H. A. Wenner and G. R. Dubes, unpublished data.
12. *Virulence* is used here as an expression of the paralytogenic capacity and was determined using the undiluted virus pool and several serial tenfold dilutions therefrom as inocula. Comparisons of virulence were made with appropriate corrections for differences in plaque titer between the virus pools being compared.

18 July 1956

Influence of Crystalline Elastase on Experimental Atherosclerosis in the Chicken

Elastase is a pancreatic enzyme that has been studied and described by Baló and Banga (*1*). Lansing (*2*) and Carter (*3*) have determined that it comes from islet tissue and specifically from the α-cells. Preparation of crystalline elastase from beef pancreas has been reported by Banga (*4*) and from pork pancreas by Lewis, Williams, and Brink (*5*).

It is thought that there may be a connection between elastase and arteriosclerosis. Baló and Banga (*6*) noted that men suffering from arteriosclerosis had less elastase in the pancreas than did healthy individuals, and Lansing (*7*) gave elastase by mouth to cholesterol-fed rabbits and found that it retarded the development of atheromatosis.

We report here the influence of crystalline porcine elastase (*8*), given orally and parenterally, and of trypsin, included as a control for the proteolytic action, on atheromatosis and plasma lipid pattern in cholesterol-fed chickens. Two preparations of crystalline material containing 130 and 134 elastase units per milligram were tested in separate experiments 24 weeks apart. The procedures are described in more detail elsewhere (*9*).

For each test, six groups of 8-week-old White Leghorn cockerels, raised on starter ration, were set out on diet containing 2 percent USP cholesterol and 5 percent cottonseed oil and treated as follows: (i) no further treatment; (ii) diet fortified with 57 mg of crystallized trypsin (Worthington) per kilogram; (iii) diet fortified with 57 mg of elastase per kilogram; (iv) given 0.2 ml of saline intramuscularly five times per week; (v) given 4 mg of crystallized trypsin intramuscularly five times per week; (vi) given 4 mg of elastase intramuscularly five times per week.

After 8 weeks of treatment, the birds were fasted overnight, bled, and sacrificed. Four milliliters of blood was drawn from the alar vein of each bird and mixed with 0.7 ml of solution of citric acid, sodium citrate, and dextrose (ACD solution) (*10*). The prepared plasma samples were analyzed for total cholesterol (*11*) and lipid phosphorus (*12*) and for cholesterol in α- and β-lipoprotein after fractionation by Cohn's method 10 (*10, 13, 14*). The thoracic aortas and brachiocephalic arteries were removed and examined for degree of atheromatosis by two independent observers. A score of 1 was assigned for thin, scattered plaques; a score of 2 for either light, uniform deposit or heavy, scattered plaques; a score of 3 for heavy, uniform deposit; and a score of 4 for extremely heavy and lumpy deposit.

The results are shown in Table 1. Lipid concentrations in ACD plasma should be multiplied by 1.3 to obtain corresponding serum values.

Food consumption data showed that the average enzyme intakes by birds on the dietary regimens in the first experiment were 4.9 mg of trypsin per day and 4.4 mg of elastase per day. In the second experiment, the intakes were 4.5 mg of trypsin per day and 4.3 mg of elastase per day. Samples of different lots of diet were analyzed by U. J. Lewis, who found that there was no loss of enzyme activity in them before they were consumed.

The two experiments differed in the severity and incidence of atheromatosis. The injected birds seemed to have higher α-lipoprotein cholesterol and a higher $\alpha/(\alpha+\beta)$ ratio than those on dietary regimens.

Crystalline elastase, given either in the diet or by intramuscular injection, did not reduce either incidence or severity of atheromatosis in cholesterol-fed chickens. The elastase-treated birds gained less weight on the average, and had slightly more α-lipoprotein cholesterol ($p < 0.05$) than their companions. The lipid patterns were not otherwise influenced in a direction that would be considered beneficial in man.

DAVID M. TENNENT, MARY E. ZANETTI, WALTHER H. OTT, GUNTHER W. KURON, HENRY SIEGEL

Merck Institute for Therapeutic Research, Rahway, New Jersey, and Albert Einstein College of Medicine, Bronx, New York

Table 1. Lesion scores, plasma cholesterol concentrations, and distributions between lipoproteins, plasma lipid-phosphorus concentrations, ratios of cholesterol to phospholipid (C/PL), and weight changes in control and treated cockerels.

Substance	Lesions		Cholesterol (mg/ml)				Lipid P (μg/ml)	C/PL	Wt. gain (g)
	Incidence	Avg. score	Total	α-Lipoprotein	β-Lipoprotein	$\frac{\alpha}{\alpha+\beta}$			
Experiment 1, Enzyme in the diet									
None	5/10	0.9	3.56	0.27	3.29	0.12	55.0	2.21	939
Trypsin	4/10	0.6	2.32	0.26	2.02	0.13	40.4	2.27	1042
Elastase	8/10	1.55	4.40	0.37	3.89	0.11	55.4	3.00	927
Experiment 1, Intramuscular injection									
Saline	4/10	0.45	2.14	0.33	1.83	0.16	43.4	1.94	984
Trypsin	3/7	1.0	3.33	0.35	2.78	0.14	54.7	2.37	896
Elastase	3/10	0.5	4.28	0.65	3.34	0.16	63.3	2.50	775
Experiment 2, Enzyme in the diet									
None	7/10	1.7	4.75	0.37	4.39	0.10	60.3	2.99	1007
Trypsin	8/10	1.5	3.31	0.33	2.98	0.11	54.7	2.37	1007
Elastase	9/10	1.95	4.54	0.39	4.16	0.09	62.3	2.85	966
Experiment 2, Intramuscular injection									
Saline	8/10	1.7	4.68	0.41	4.17	0.12	63.6	2.99	957
Trypsin	7/9	1.45	4.41	0.46	3.88	0.13	64.5	2.51	918
Elastase	8/9	1.9	4.66	0.52	4.09	0.12	64.6	2.66	891

References and Notes

1. J. Baló and I. Banga, *Biochem. J.* (*London*) 46, 384 (1950).
2. A. I. Lansing, T. B. Rosenthal, M. Alex, *Proc. Soc. Exptl. Biol. Med.* 84, 699 (1953).
3. A. E. Carter, *Science* 123, 669 (1956).
4. I. Banga, *Acta Physiol. Acad. Sci. Hung.* 3, 317 (1952).
5. U. J. Lewis, D. E. Williams, N. G. Brink, *J. Biol. Chem.*, in press.
6. J. Baló and I. Banga, *Acta Physiol. Acad. Sci. Hung.* 4, 187 (1953).
7. A. I. Lansing, *J. Gerontol.* 9, 362 (1954).
8. We are greatly indebted to U. J. Lewis and E. L. Rickes, who prepared the crystalline elastase used here.
9. D. M. Tennent *et al.*, in preparation.
10. E. J. Cohn *et al.*, *J. Am. Chem. Soc.* 72, 465 (1950).
11. L. L. Abell *et al.*, *J. Biol. Chem.* 195, 357 (1952).
12. E. J. King, *Micro-analysis in Medical Biochemistry* (Churchill, London, England, 1951), p. 67; D. E. Zilversmit and A. K. Davis, *J. Lab. Clin. Med.* 35, 155 (1950).
13. W. F. Lever, *J. Clin. Invest.* 30, 99 (1951).
14. E. M. Russ, H. A. Eder, D. P. Barr, *Am. J. Med.* 11, 468 (1951).

13 June 1956

Letters

Scientific Method, Statistical Inference, and the Law

Something *other* than despair must motivate the scientist "who watches the instruments of his calling, and his reluctance to claim certainty, turned against him." Two recent editorials [*Science* **123**, 1059 (15 June 1956) and 1099 (22 June 1956)] have pointed up difficulties in the understanding of scientific method at hearings conducted by the Federal Trade Commission; the second reference included (on page 1107) an even more complete account of the utter lack of understanding of the most elementary principles of statistical reasoning by that same governmental agency. Such lacunae in intellectual armor, however, are not solely the possession of the legal talent of the FTC. It is our observation based on a limited sample but a sample of sufficiently large size, with not a single exception, to warrant at least the tentative hypothesis: the vast majority of those professionally concerned with the law are equally deficient in their understanding of those same principles of scientific inference.

Every day life is becoming more surrounded with affairs closely related to the scientific laboratory. Intimately associated with advances in technologic processes are the objective criteria by which the scientist reaches his conclusions. Similarly the lawyer, to best represent the interests of his client, must familiarize himself not only with the "technologic processes" of the situation in question but also with certain basic statistical reasoning, a primary ingredient in scientific analysis of evidence. The necessary statistical reasoning is not only intuitive and natural but also extremely useful and applicable to a broad spectrum of legal cases. An objective of this communication cannot be to present all possible examples of statistics applied to legal situations, but it can point up some ideas underlying statistical decision making and point out the similarity of these concepts with some of those concepts already accepted in the law. To this end we first outline some general analogies.

The thinking of the experimentalist, be he pure or applied, must of necessity be based on statistics: he must analyze data obtained by observation; and the only available objective methods of accomplishing this analysis are provided by the discipline of statistics. To digress for a moment, it should be mentioned that theoretical statistics, which develops the abstract logic on which the applications rest, might be considered as a branch of applied mathematics and has its foundations in the theory of probability. However, the applied statistician, dealing with the real facts of a physical world, must be more than a mathematician if he is to work on the same team with researchers in any field of investigation who have concrete problems facing them for which solutions in the real world must be discovered.

A qualitative analogy can be made between the thinking of the experimentalist and that of the lawyer in his situation. Although the lawyer may not have been aware of it, he is trained to think and reason in a manner similar to the scientist. Perhaps he has not been conscious that his processes of deducing conclusions are—in principle—the same as those of the scientist; the lawyer may have been unaware of this fact, because he has given the scientist too much credit for "precision." Take the legally familiar phrase, "beyond a reasonable doubt." The phrase very scrupulously does not say, "with certainty" or "beyond a doubt"; the legal phrase carefully includes the word *reasonable*.

The scientist, too, never proves everything "with certainty" or "beyond a doubt"; the best he can ever hope to say is that he has established a fact "beyond a *reasonable* doubt." The difference between the experimental and the legal situations is that the scientist has learned how to calculate the probability of the doubt. This has been the contribution of statistics.

We need not go into detail with the scientific measurement of experimental uncertainty. One hypothetical example will serve to illustrate. Suppose that a medical researcher comes up with a new treatment. The results of the experiments he conducts to evaluate his treatment are almost never black or white, but usually one of the shades of gray: more patients may improve with the new treatment than usually show improvement with the traditional treatment. (The key word here is *usually*: associated with any phenomenon there is almost always variation. For example, on the average, 70 percent of patients may recover from a disease inside of a week, in the long run. But given the next five groups of 100 patients each, we should not be surprised to see as few as 60 or 65 patients or as many as 75 or 80 patients recovering inside of a week in some of the groups. Almost certainly not all five groups of 100 patients will have the same number recovering inside of a week.) Here statistics comes to the rescue and aids in evaluating the experiment by analyzing the pattern of variation as follows: If there is no more merit to the new treatment than to the old treatment and if we repeated our experiment under identical conditions many times over, then by chance alone we would observe differences at least as large as those in our experiment in less than, say, one out of 10 such experiments (or one out of 20, or 100, or 1000, and so forth.) The one out of 20, or one out of 100, and so forth, is the doubt that remains. What we choose to call "reasonable doubt," or what we class as "beyond reasonable doubt" depends on the consequences of a wrong decision. Indeed, this type of reasoning is not new to the law; some philosophers of the law have implicitly set an upper limit for "reasonable doubt" for criminal actions: "Better that 100 criminals shall go free than to unjustly convict one innocent person."

Until now we have dealt with the broad analogies between decision making in experimental science and in courts of law. We now turn to a special class of legal cases to illustrate more specifically how statistical sampling procedures fit into the lawyer's "bag of tools."

More and more legal actions depend for their bases in fact on the results of experiment. Since experimental results vary, any experiment establishes a "fact" only within a certain area of doubt; and the lawyer should be aware of the existence and extent of these areas. One specifically controversial set of facts are those arising as the result of a sampling process. This particular field is one that has been given much study by statisticians, and a great deal is known about the subject. In a recent paper ["Legal aspects of sampling: recent developments." *Trans. Am. Soc. Quality Control* (1955)] Frank R. Kennedy, of the College of Law at the State University of Iowa, has given an excellent summary and bibliography of legal cases depending to greater or lesser extent on evidence obtained by sampling. Among other examples, he cites the Food and Drug Ad-

---

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see *Science* **124**, 249 (10 Aug. 1956).

ministration as having "had a considerable amount of experience in the courts with its sampling procedures." The facts are that the Food and Drug Administration regularly condemns products on the basis of their agents' inspection of samples of shipments. Unfortunately, owing to the lawyers' naivete concerning statistics, counsel for the defendants have too infrequently attacked the Government's cases as being based on inadequately designed samples. Kennedy points out that the burden of the proof of the adequacy of the sampling procedure is the Government's.

Kennedy, in addition to other references, cites certain actions involving the Federal Trade Commission wherein sampling devices were used in order to better arrive at the facts. One of us has recently been involved as an expert in hearings of an organization before an examiner of the Federal Trade Commission. The case in point was an antitrust action, and the basis of the charge depended in part on the size of the total market of the product involved; this fact could not be definitely ascertained from any source, governmental or private. Other than estimates which were admitted to be sheer guesswork, there were no public "statistics" on the size of the market. It so happened that the respondent, in the usual course of business, had made market research studies on a random sampling basis. Along with the expert knowledge of company employees in the use of the collected data, these could be projected to a rather precise estimate of the total market. The point of interest here is that the very competent legal counsel available to *both* sides in the case were out of their depth when it came to understanding the testimony concerning these relatively simple statistical techniques.

As Kennedy concludes, "The use of sampling in the courts is increasing." The use of statistics is increasing in many areas where the legal expert must be at home. Statistical methodology and theory, tied up as it is in all scientific investigation, is becoming a more important technique to have at one's command.

It is especially important that the lawyer, if he is to represent properly his client in any of a host of civil or criminal actions, make himself familiar with this basic logic which, in essence, is similar to his own. The lawyer who does not is falling behind the pace of his times and failing the clients who place their confidence in him.

Be it understood that we have no intention of suggesting that lawyers must become technically proficient in scientific and/or statistical method. But some concerted effort, by responsible individuals and groups of scientists, is in order to get these ideas across to similar individuals and groups in the legal profession. The single most evident group on each side seems apparent. The AAAS, as the largest and most influential organization of scientists in the United States, might well consider the possibility of approaching the various bar associations with a fixed objective: the aiding of the members of the legal profession in becoming acquainted with the elements of scientific method and reasoning. Such a *rapprochement* could lead only to better understanding of science in the courts, better hearings, better decisions; it could be the beginning of the end of such farcical exhibitions as those in the hearings to which allusions were made in the editorials in *Science* mentioned earlier. Indeed, this could be the alternative to despair.

GAYLE W. MCELRATH
Industrial Engineering Division
JACOB E. BEARMAN
Biostatistics Division,
University of Minnesota, Minneapolis

Of Books and Reading

Many persons were greatly shocked at the conclusions of the American Institute of Public Opinion which were referred to in the editorial "Of books and reading" [Science **123**, 703 (27 Apr. 1956)]. In an effort to become better informed on the subject, I have on four occasions requested additional information from the institute.

Points covered in these letters were as follows:

1) Have background studies been published on how the statistics were compiled, and are detailed tables available to the general public or libraries?

2) Has Gallup written a general article describing the techniques that would be applicable to a better understanding of the results?

3) Has the information contained in the institute's releases been expanded, commented upon, or amplified in any published work?

4) How many people were interviewed and what mode of sampling was used?

In response to my first inquiries, two news releases were received without comment and, finally, a brief letter from one of the editors, which indicated that to his knowledge the information in the release had not been expanded or commented upon. A letter sent for the personal attention of Gallup elicited no response. None of the information provided by the institute gave a definite answer to any of the questions raised.

It seems to me that an institution which is so widely regarded as an authority in the field of public opinion has a responsibility to provide its readership with at least some basic facts on how such a poll is conducted. If the institute is unwilling or unable to do so, it is my opinion, and that of many of my business and professional associates, that the institute's methods, perhaps unjustly, are open to criticism. I am taking the liberty of communicating this information to *Science* because the aforementioned editorial had, no doubt, great weight with readers and might be considered an endorsement of the findings. Should the matter be permitted to rest?

LEO WALLERSTEIN
Wallerstein Company, Inc.,
New York, New York

Periodically we study the book-reading habits of the American public and those of the people of other countries where we have affiliated organizations.

In the studies which have been reported, the results were based on this question put to all persons interviewed: "Do you happen to be reading any books or novels at present?" Those replying "yes" were then asked: "Which one(s)?"

In the tabulations we exclude reading of the Bible. In the most recent of these studies, we found that 17 percent were reading a book.

To find out how long it has been since the respondents have read a book, we have asked: "When, as nearly as you can recall, did you last read any book other than the Bible?" And then: "Can you recall the name of the book you last read?"

Every sample has been based on a true cross-section of the adult population of the country. These samples are based on from 1500 to 3000 personal interviews. In the language of statisticians, we use a "modified probability" sample.

Our standard procedure is to ask each respondent a great many "control" questions: education, age, sex, and religion, and so on. It is possible in this way to make certain that each cross-section is representative of all segments of the population, and it is possible to discover the reading habits of each segment.

Our methods have been described *ad nauseam.*

A few years ago the Survey Research Center of the University of Michigan undertook a national survey which provides data on book reading. The findings are contained in a book *The Library's Public* by Bernard Berelson. I strongly urge Wallerstein to consult this report.

One of the unfortunate features of our work in the Gallup Poll is that we do not have the time or the money to incorporate our findings in magazine or book form. Someday we hope we can interest a foundation in providing the funds for this purpose.

GEORGE GALLUP
American Institute of Public Opinion,
Princeton, New Jersey

Book Reviews

Reactor Shielding Design Manual. Theodore Rockwell, III, Ed. Van Nostrand, Princeton, N.J.; McGraw-Hill, New York, 1956. 472 pp.; 481 pp. Illus. $6.

This is the first book to appear that is devoted exclusively to the subject of radiation shielding for nuclear reactors. The work was sponsored by the U.S. Atomic Enery Commission at the instigation of H. G. Rickover, and it was published simultaneously by the two book companies. The compilation of techniques, formulas, and data for use in calculations is based on work in the naval reactor program and the pressurized water reactor program. The information appears to be applicable not only to reactors but to systems using fission-product and cobalt gamma-ray sources.

Chapters 1 and 2 contain well-written basic descriptions of radiation attenuation and dosage limits. Chapters 3 and 4 tell how to determine radiation source strengths and how to design shields for the reactor core and cooling system.

Chapters 5, 6, and 7 provide general engineering principles and data on materials and sources of radiation in reactors. Chapter 8 is devoted to the effect of ducts and voids, and Chapter 9 tabulates geometric transformations and special useful integrals. Chapter 10 provides attenuation coefficients, build-up factors, and nuclear data. The book is replete with graphs and illustrative numerical examples.

The material in the various chapters is well-integrated and demonstrates careful editing. The technical level is such that it may be readily understood by both scientists and engineers. A sampling of the contents indicates that the book is quite comprehensive. One feature that is unfortunately missing is emphasis that authors such as Blizard place on certain principles—for example, that shield design is an art rather than a science, that the unusual radiation is the important one, and that comparison methods are very powerful. If such viewpoints are understood, the book serves as an invaluable source of numerical data and formulas. It is difficult to see how the book could conveniently be used as a text, but it is certain that it should find a prominent place in reference shelves for nuclear engineering classes, for reactor designers, and for those engaged in radiation research.

The editors, authors, and contributors are to be commended for the preparation of this useful addition to the literature of reactor technology.

RAYMOND L. MURRAY
Department of Physics,
North Carolina State College

Floods. William G. Hoyt and Walter B. Langbein. Princeton University Press, Princeton, N.J., 1955. ix + 469 pp. Illus. $7.50.

William G. Hoyt has been concerned with the many facets of stream flow, of which floods are the most spectacular and costly, for most of his professional career. For many years he was a member of the U.S. Geological Survey, the principal agency responsible for measuring flood flows and studying the conditions that result in them. Later he became director of the Division of Water and Power of the U.S. Department of the Interior, where he was in a position to study many of the proposals for engineering structures to control floods. Walter Langbein was a close associate of Hoyt's for many years on the survey, and his principal hydrologic interest likewise has been the characteristics of stream flow.

To find two men as well informed on the whole range of flood problems would be difficult indeed, and their book reflects their long and intimate acquaintance both with flood phenomena and with the engineers and scientists who are engaged in the field of water supply and water management.

The book is uncommonly timely, for within the last year parts of the nation have experienced devastating drouths and serious water shortages, and other areas, notably New England and California, have suffered disastrous floods. Thus, the nation is more alive than ever before to the enormous and often needless loss of money, lives, and property that is exacted yearly by destructive floods.

The differences of opinion concerning the best ways to control floods are so serious that an understanding of the hydrology of floods has become essential to sound planning of the nation's water management.

The authors begin by establishing the fact that, since the birth of civilization, man, by settling in the fertile flood plains of the world, has exposed himself and his property to losses by floods. By encroaching on stream channels with bridge piers and other structures, he has reduced the area through which floodwaters may pass and has thereby increased the height of flood stages. The authors describe clearly the essential facets of a sound approach to flood problems and the many and varied causes of those problems; the life history of a typical flood; and the estimation of flood damages. A chapter on man's adaptation to floods discusses our present national policy toward floods, which is primarily one of "flood protection." This policy has as its purpose the construction of various types of engineering works that will enable full-time occupancy of lands within the flood plains.

Since there is no specific provision either in the Constitution or in the Amendments thereto relating to floods, the federal flood control program has developed slowly and in a piecemeal fashion. The authors present an excellent résumé of our flood-control policy, pointing out that much of it is predicated on assumptions for which satisfactory proof is lacking. The problems, projects, and plans for individual major basins are well presented. The book contains nearly 100 pages of a well-documented chronology of floods in the United States, beginning with the Mississippi River flood of 1543, which hindered the explorations of the Spaniard De Soto.

The book is well printed and bound, and for the most part highly readable. It should serve as a splendid source book for the layman who wishes to understand the flood problem and his government's attempts to cope with it in different parts of his country. He must not, however, expect that the most optimistic plans will anticipate complete protection from floods. Major storms will still produce floods, but the effects can be ameliorated.

A. N. SAYRE
U.S. Geological Survey

Methods of Biochemical Analysis. vol. III. David Glick, Ed. Interscience, New York, 1956. 437 pp. Illus. $9.50.

The objectives of this series are to review recently developed and improved methods used in biochemistry, to critically evaluate them, and to present the best methods available in enough detail to enable the individual to carry out the analyses. The authors represented in the third volume have done commendable

work in carrying out these objectives. In general, the applications and the limitations of the various methods are clearly and concisely discussed. The recommended methods are very well presented, and possible sources of error and areas where caution must be observed are pointed out.

This volume is an improvement over the previous volume in that an attempt has been made to discuss methods for related topics in the same volume. For example, about a third of volume III is devoted to methods for polysaccharides, while another third is devoted to the determination of metal complexes and metallic ions.

The group of methods of general interest includes the determination of organic phosphorus compounds, assay of thioctic acid, the determination of histamine, and spectrophotometric methods for the determination of uric acid, hypoxanthine, adenine, and xanthopterine.

The group of subjects related to carbohydrate structure includes the use of periodate oxidations, end-groups analysis of polysaccharides, and the use of infrared analysis in the determination of carbohydrate structure.

The remaining third of the volume is devoted to the measurement of complex ion stability by the use of ion-exchange resins, analysis of metal-protein complexes, application of metal buffers and metal indicators, determination of zinc and flame photometry, and spectrometry.

This volume is an excellent addition to the series on biochemical methodology. It should be of considerable value to the research biochemist.

JAMES R. GILLETTE
Laboratory of Chemical Pharmacology, National Heart Institute, National Institutes of Health

Studies of the Psychology and Behavior of Captive Animals in Zoos and Circuses. H. Hediger. Translated by Geoffrey Sircom. Butterworths, London, 1955. vii + 166 pp. Plates. 30s.

H. Hediger, director of the Zoological Gardens at Zurich and professor of animal psychology at the University of Zurich, says: "To me, the animal psychologist seems like a cave explorer, who, making his way through impressive tunnels, finds himself groping at the threshold of some lofty cavern, access to which will some day be granted to his astonished gaze." Hediger has traveled in Europe, the United States, Africa, and the South Pacific islands, always observing the behavior of animals both in captivity and in their native wilds. He has followed his former book, *Wild Animals in Captivity*, with this one, which treats of the psychology of animals.

This is a comprehensive book and attacks many problems. The animals' flight reaction, for instance, is the distance at which an animal becomes alarmed by man or by an enemy, and at which it runs away. Hediger has actually measured the number of feet at which an African buffalo in the wilds will take alarm, and compared it with the distance that alarms a buffalo on a reserve where he has learned that he is safe. The "need to escape" is a greater drive with animals than sex or hunger.

A study of animal tracks, both in the zoo and in the wild, shows that animals, like man, tend to follow certain paths. Of freedom, he says, "It has two aspects; one for the predator that is lucky enough to find a particularly tasty victim; and another for the victim that is lucky enough to escape from a particularly dangerous enemy."

He has not confined his studies to the big, showy zoo animals, but has an interesting chapter on the so-called "hypnosis" exercised by snakes, and a study of "fascinatory organs" used by some snakes to decoy their prey.

The social relationships among animals are discussed all through the book —even the social significance of antlers in deer. When different species live together, one is always dominant. There are fascinating accounts of fighting ceremonials and of mating ceremonials, though Hediger says that too little is known about preliminary courtship rituals except in the case of some birds.

The relations of male animals to the young, of females to their young, and of the young to each other are studied. Begging among zoo animals is said to be not only a request for food but for companionship.

The psychology of circus animals differs from that of zoo animals because of their much closer contact with trainers, grooms, and in some cases with the public.

Descriptions of animals at play include accounts of his visits to the famous trained animals at the St. Louis Zoo and the porpoises at Marineland.

The book is full of interesting information—for example, that the giant sloth of Patagonia was probably kept as a sort of domestic animal by the aborigines; that the Watussi cattle are kept ceremonially, and are not butchered, milked, or bled (their only use is to furnish dung for fuel and urine for bathing purposes); and that, if a dog bites a man, it may be because he regards the man as a social rival.

There are informative notes on the birth of a giraffe and the birth of a kangaroo, and on the sleeping habits of elephants.

The book is divided into 11 chapters, such as "The animal's expression," "Animal psychology in the circus," "Wild and domestic animals," "Mother and child," and "Animals among themselves." The photographic illustrations are unusually good.

This is a book that provides worthwhile reading which nature lovers may read with interest and enjoyment and then put in a nearby file as an excellent reference book. A bibliography of 197 titles is included.

W. M. MANN
National Zoological Park

Précis de Géologie. Leon Moret. Masson, Paris, ed. 2, 1955. ix + 669 pp.

It is very helpful for the American teacher of geology to learn how his subject is presented in other parts of the world. This book by Leon Moret of the Ecole Nationale Supérieure d'Hydraulique at Grenoble, gives an excellent survey of the science of geology as it is taught in French institutions of learning.

One need have no worry concerning the geologic background of our French colleagues, if we can assume that they are familiar with all the information in Moret's book. The book covers both physical and historical geology, and although the organization may differ from most American textbooks, the over-all coverage is about equal to that presented to our geology majors in a first-year course.

The first part of the book, after an introduction in which some general principles of geology are discussed, is mostly concerned with the various rocks and minerals that make up the surface of the earth. The discussion on the classification of minerals and crystals is especially well written.

This book goes on to discuss fossils and the various principles of stratigraphy. There is an abbreviated summary of classification as well as a brief résumé of the main faunal and floral elements of the different major periods.

The third part concerns tectonics, and while this part may be a little more thorough than that given in most comparable American textbooks, the section should be of considerable interest to the somewhat more advanced student.

The fourth part consists of an excellent survey of historical geology, with special emphasis on events in France and elsewhere in Europe. This section leans heavily on the work of Gignoux, to whom suitable credit is given. This section should be very useful to American students who wish to learn more details, especially concerning events in Europe, than are given in the average American

textbook. The listing and explanation of standard European time units, such as Turonian, Danian, and so forth, are very helpful.

There are certain differences in terminology from those generally used in the United States. For example, following earlier custom, the Silurian is regarded as the Lower Ordovician, and the terms *Primary* and *Secondary*, obsolete in America, are used for the Paleozoic and Mesozoic, respectively.

There are 322 drawings and maps that supplement the text, and also a bibliography, mostly of French works, that covers all sections of the book except historical geology, for which the reader is referred to the work of Gignoux.

I found the book most interesting and well organized. It might well be assigned as collateral reading to seniors and candidates for higher degrees. Not only would it improve their knowledge of French, but it would also prove helpful in giving somewhat different viewpoints of certain problems and in filling in gaps, especially in reference to events that took place in the geologic history of Europe.

HORACE G. RICHARDS
Department of Earth Sciences, University of Pennsylvania and *Academy of Natural Sciences*

The Negro Potential. Eli Ginzberg. Columbia University Press, New York, 1956. 144 pp. $3.

Concern for human resources should grow increasingly in view of the serious shortage of personnel in scientific and technical fields—and in all fields, so my colleagues insist. Some of the factors that affect the participation of a social group in the activities of society are ably discussed by the director of the conservation of human resources project at Columbia University, Eli Ginzberg, professor of economics, and his associates. This slim volume, which is the second major publication of the project [the first was *The Uneducated* (1953)], reports the results of a study of the Negro in the United States, supported by a judicious selection from the documentary material bearing upon the problems of the Negro.

In the six chapters the authors focus their attention in turn upon: (i) "The challenge of Negro potential"; (ii) "Expanding economic opportunities"; (iii) "The educational preparation of the Negro"; (iv) "The Negro soldier"; (v) "Better preparation for work"; and (vi) "Lessons for manpower policy." The second longest chapter, the fourth, is probably the most significant, for it deals with the Negro soldier, and it is in the armed forces that the most thorough integration of the Negro has been achieved. The authors handle their material here, as throughout the book, in a candid, objective manner, balancing fact against fact without any tendency toward an extreme position. Part of their conclusion is: "But integration in services has demonstrated the remarkable ability of both whites and Negroes to adjust to new relations with each other in such a manner that the potential of each can be more fully realized." The book quotes a 1955 report from the U.S. Department of Defense which states: "Thorough evaluation of the battle-tested results to date indicates a marked increase in overall combat effectiveness through integration. Economies in manpower, material, and money have resulted from the elimination of racially duplicated facilities and operations."

In my opinion, the material in the final chapter, "Lessons for manpower policy," deserves especially wide dissemination. If two statements made and carefully supported by the authors find wide acceptance, the book will make a salutary contribution to the perspective that is essential for intelligent planning to meet these national problems. The first of these is a quotation and appears earlier in the text: "Most social scientists now believe that there are no inborn differences in intellectual potential between Negroes and the rest of the population, or that such differences, if they exist, are very small." The second is the opening paragraph of the final chapter: "It is never sensible or right for a nation to waste valuable human resources through failure to develop or utilize them. The consequences of such waste are a lower level of national strength and individual well-being."

This is a significant study which should be read especially by all persons concerned with programs for relieving the shortage of personnel in science and engineering. Clearly there is no a priori reason that every distinguishable social group should contribute to each scientific or other field to an extent that is commensurate with its population ratio. However, the 1956 figures on medical-school graduates would suggest that something should be done with respect to the Negro. Of the 6997 persons who graduated in June 1956 from 87 medical schools, 173 were Negroes, with 132 graduating from Howard and Meharry. Yet there are 16 million Negroes in this country, roughly one-tenth of the population, and a number equal to the population of Canada. A careful study of this book is an indispensable prerequisite for intelligent action in righting such imbalances.

HERMAN BRANSON
Department of Physics, Howard University

Books Reviewed in The Scientific Monthly, October

Virginia at Mid-Century, J. Gottmann (Holt). Reviewed by M. C. Prunty, Jr.

Carl Friedrich Gauss: Titan of Science, G. W. Dunnington (Exposition Press). Reviewed by E. A. Cameron.

Free Skin Grafting in Patients with Extensive Defects, B. A. Petrov (State Publishing House of Medical Literature, Moscow). Reviewed by S. A. Corson.

Microbiology, F. C. Kelly and K. E. Hite (Appleton-Century-Crofts). Reviewed by H. M. Rose.

The Principles of Mechanics, H. Hertz, translated by D. E. Jones and J. T. Walley (Dover). Reviewed by J. Turner.

Birthplace of the Winds, T. Bank II (Crowell). Reviewed by F. de Laguna.

Guided Missiles in War and Peace, N. A. Parson, Jr. (Harvard University Press). Reviewed by S. F. Singer.

The Piltdown Forgery, J. S. Weiner (Oxford University Press). Reviewed by W. L. Straus, Jr.

Indians of the Northwest Coast, P. Drucker (McGraw-Hill); *The Coast Salish of British Columbia*, H. G. Barnett (University of Oregon Press). Reviewed by R. F. Spencer.

The Antarctic Challenged, E. R. G. R. Evans (De Graff). Reviewed by L. M. Gould.

Oeuvres de Lavoisier. Correspondance, R. Fric, Ed. (Albin Michel). Reviewed by E. Rosen.

New Books

Ceramics for the Archaeologist. Publ. 609. Anna O. Shepard. Carnegie Institution of Washington, Washington, D.C., 1956. 414 pp. Cloth, $7.75; paper, $6.75.

Handbuch der Physik. vol. 1, *Mathematical Methods*. 364 pp. DM. 72. vol. XLVII, *Geophysics*. 659 pp. DM. 118. S. Flugge, Ed. Springer, Berlin, 1956.

Behavior Theory and Conditioning. Kenneth W. Spence. Yale University Press, New Haven; Geoffrey Cumberlege, Oxford University Press, London, 1956. 262 pp. $4.50.

Technique of Organic Chemistry. vol. II, *Catalytic, Photochemical, and Electrolytic Reactions*. Arnold Weissberger, Ed. Interscience, New York, ed. 2, 1956. 543 pp. $11.50.

An Introduction to Modern Organic Analysis. Sidney Siggia and Hans J. Stolten. Interscience, New York, 1956. 250 pp. $4.50.

Experimental Physical Chemistry. Farrington Daniels, Joseph H. Mathews, John W. Williams, Paul Bender, Robert Alberty. McGraw-Hill, New York, ed. 5, 1956. 482 pp. $6.50.

Science in Progress. Ninth Series. George A. Baitsell, Ed. Yale University Press, New Haven, Conn.; Geoffrey Cumberlege, Oxford University Press, London, 1956. 343 pp. $6.50.

Grinnell Workbook in Biology. Biology Staff, Grinnell College. Norman H. Russell, Jr., Ed. Burgess, Minneapolis, 1956. 56 pp. $1.75.

Meetings and Societies

Election of AAAS Officers

The AAAS Committee on Nominations has selected the following lists of candidates for the offices of president-elect and members of the Board of Directors.

President-elect (one to be elected)
Wallace R. Brode
Paul E. Klopsteg

Members of the Board of Directors (two to be elected)
Clarence E. Davies
Bentley Glass
Paul E. Klopsteg
Randolph T. Major
Alan T. Waterman

These candidates were selected by the committee on the basis of a preliminary balloting of AAAS Council members. In accordance with the new election procedures adopted last year by the Council, names may be added to either of these lists upon submission to the executive officer of a petition signed by 30 or more members of the Council, provided that such a petition is received *by 1 November*. Ballots for election by preferential mail vote will be sent to Council members about 10 November. The results of the election will be announced on 27 December at the Association's 1956 annual meeting in New York. Biographical data concerning each proposed candidate follow.

Wallace R. Brode, 56 (chemistry, spectroscopy), assistant chemist, University of Illinois, 1921–24; assistant chemist, National Bureau of Standards, 1924–26; associate chemist, Bureau of Efficiency, 1926; Guggenheim Foundation fellow, Leipzig, Zurich, and Liverpool, 1926–28; assistant professor of chemistry, Ohio State University, 1928–32, associate professor, 1932–39, professor 1938–48; liaison office, Office of Scientific Research and Development, 1944–45, head, Paris office, 1944–45; head of the science department, Naval Ordnance Test Station, Calif., 1945–47; associate director, National Bureau of Standards, 1947–. Associate editor, *Journal of the Optical Society of America*, 1941–50, editor, 1950–.

AAAS activities: Member of Board of Directors, 1953– and Executive Committee, 1953–; member, Editorial Board, 1952–; member, Building Committee, 1954–55 and Investment and Finance Committee, 1955–; chairman, Committee on Constitution, Bylaws, and General Operations, 1953–55.

Paul E. Klopsteg, 67 (physics), assistant in physics, University of Minnesota, 1911–13; instructor and later assistant professor, 1913–17; development engineer, Ordnance Department, U.S. Army, 1917–18; physicist, Leeds & Northrup Co., Philadelphia, 1918–21; director of research and manufacturing, Central Scientific Co., Chicago, 1921–30, president, 1930–44, director, 1921–; professor of applied science, Northwestern University, director of research, Northwestern Technological Institute, 1944–54; assistant director for physical sciences, National Science Foundation, 1951, associate director since 1952; deputy chief, instruments section, National Defense Research Committee, 1940–41, chief, physics (special devices) division, 1941–45; assistant chief, office field service, Office of Scientific Research and Development, 1944–45; chairman, committee on artificial limbs, National Research Council, 1945–; member of the board of governors and chairman, Argonne National Laboratory, 1949–50. Modern Pioneers' award, National Association of Manufacturers, 1940; Presidential Medal for Merit, 1948; cofounder, American Association of Physics Teachers, 1930, president, 1953; member of the governing board, American Institute of Physics, 1930–45, chairman, 1938–45.

AAAS activities: member of the Board of Directors, 1949– and Executive Committee, 1953–; member, Building Committee, 1952–54, and Investment and Finance Committee, 1950–54.

Clarence E. Davies, 65 (mechanical engineering), production engineer, Remington Typewriter Co., 1914–17, production supervisor, 1918–20; associate editor, American Society of Mechanical Engineers, 1920–21, assistant secretary and managing editor, 1921–31, executive secretary, 1931–34, secretary, 1934–. President, Newcomen Society, 1939, 1940.

AAAS activities: vice president and chairman, Section M, 1952–56; member, Committee on AAAS Meetings, 1956; member, Committee on Membership Development, 1953–; member, Committee on Revision of the Constitution and Bylaws, 1948–52; member, Committee on Constitution, Bylaws, and General Operations, 1953–55.

Bentley Glass, 50 (genetics), teaching fellow, Baylor University, 1928–29; National Research Council fellow, genetics, Oslo, Kaiser-Wilhelm Institute and Missouri, 1932–34; instructor in zoology, Stephens College, 1934–38; assistant professor of biology, Goucher College, 1938–42, associate professor, 1942–46, professor, 1946–48; associate professor, Johns Hopkins University, 1948–52, professor, 1952–. Consultant, U.S. Department of State, Germany, 1950–51; member of the governing board, Institute of Biological Sciences, 1951–53, chairman, 1954–; assistant editor, *Quarterly Review of Biology*, 1944–48, associate editor, 1949–; editor, *McCollum-Pratt Symposia*, 1949–; *Survey of Biological Progress*, 1954–; biology editor, Houghton Mifflin Co., 1946–; member of the board of trustees, *Biological Abstracts*, 1956–; president, American Institute of Biological Sciences, 1954–56.

AAAS activities: vice president and chairman, Section F, 1956; member, Editorial Board, 1948–; acting editor, *Science* and *The Scientific Monthly*, 1953.

Randolph T. Major, 55 (chemistry), assistant in chemistry, University of Nebraska, 1923–24; Princeton University, 1924–25, instructor and research associate, 1927–30; director of pure research, Merck & Co., Inc., 1930–36, director of research and development, 1936–47, vice president and science director, 1947–53, scientific vice president, 1953–56, scientific adviser, 1956–; professor of chemistry, University of Virginia, 1956–. U.S. Army Quartermaster Corps, 1945–47. Advisory committee, research division, College of Engineering, New York University, 1949–; member and chairman, committee on chemical warfare, Research and Development Board, 1948–52; vice president, American Foundation of Tropical Medicine, 1952–; civilian with National Defense Research Committee, 1944.

AAAS activities: vice president and chairman, Section C, 1953.

Alan T. Waterman, 64 (physics), instructor in physics, University of Cincinnati, 1916–17; Yale University, 1919–23, assistant professor, 1923–30, associate professor, 1931–48; vice chairman, division D, National Defense Research Committee, 1942–43; deputy chief, office field service, Office of Scientific Research and Development, 1943–45, chief, 1945–46; chief scientist, planning division, Office of Research and Inventions, 1946; deputy chief and chief scientist, Office of Naval Research, 1947–51; director, National Science Foundation, 1951–. Editorial Board, *American Journal of Science*; Presidential Medal for Merit, 1948.

AAAS activities: vice president and chairman, Section B, 1955.

Physiology of Reproduction

The urgent need for a concentrated research program in the physiology of reproduction was considered by a score of experts representing all sections of the the country who met on 30 June in New York, under the auspices of the Planned Parenthood Federation of America and the Population Council. This group agreed that, despite tremendous gaps in our knowledge, there does exist a sufficient base of information to justify concerted efforts to solve the known problems in this field. Although the discussions were focused primarily on improved means of birth control, the experts pointed out that the increased knowledge would also aid the 10 percent of American husbands and wives who suffer from inability to produce children.

The control of ovulation was thoroughly discussed. Promising agents in this area include hormones, plant extractives, and various new chemical compounds. Considerable work is now going on, and more is urgently needed.

Somewhat similar problems are involved in the production and maturation of sperm. It is already known that these processes can be inhibited by hormones, by nutritional controls, by chemicals, and by the application of heat to the testes, but none of these methods is satisfactory as a control of male fertility.

A third promising area of attack is the fantastically delicate process by which a sperm unites with an ovum in the upper end of the female genital tract. It is known that fertilization occurs in fluids within the oviduct and the fertilized egg wanders in the uterus for a few days before implantation. However, there is only meager knowledge of the physical and chemical properties of the fluids involved.

A fourth area calling for intensive study is the physiology of the cervix, oviduct, and uterus. The unknown factors here include the endocrine relationships of the endometrium and the musculature involved in the migrations of both sperm and egg.

The conference indicated its concern for more active work in this field of research and authorized the publication of this report in the hope of interesting additional workers in the field.

CARL G. HARTMAN
Ortho Research Foundation, Raritan, New Jersey

Meeting Notes

■ On the premise that the creative process is just as essential to industry as it is to art, a group of firms will sponsor a series of conferences on "Creativity as a process." The meetings will be organized by the Institute of Contemporary Art, Boston, Mass., with the assistance of J. J. Gordon, director of the design-invention group at Arthur D. Little, Inc.

The first conference will be held 10–12 Oct. at Arden House, Columbia University's conference center at Harriman, N.Y. It will be devoted to an analysis of the creative process. Speakers will include a museum director, an artist, a musician, a mathematician, an English professor, an inventor, and an electrical engineer. Industry, government, and educational institutions are being invited to send representatives to the conferences. Attendance will be limited to 65.

■ Facts about the design and construction of the nuclear power station at Calder Hall, England, and some of the problems overcome, will be discussed at a symposium on the plant to be held in London, 22–23 Nov. Scientists and engineers from other countries will be welcome to attend. The event is sponsored by the British Nuclear Energy Conference, which embraces the institutions of civil, mechanical, electrical, and chemical engineers, and the Institute of Physics. Special speakers on the program are Sir John Cockcroft, director of the Atomic Energy Research Establishment, and Sir Christopher Hinton, managing director of the Industrial Group of the Atomic Energy Authority.

The Calder Hall station will start feeding power into Britain's national electricity grid on 17 Oct., when it is officially opened by the Queen. By next spring the plant will be able to supply 92 megawatts of electricity.

■ The third National Symposium on Vacuum Technology will be held at the Sheraton Hotel, Chicago, Ill., 10–12 Oct. The 38-page program describes technical sessions and a panel discussion. For reservations, write to the Committee on Vacuum Techniques, Inc., Box 1282, Boston 9, Mass.

■ A Symposium on Endocrines and Nutrition is to be held at the University of Michigan, 11–12 Oct., under the sponsorship of the university's Medical School in conjunction with the National Vitamin Foundation. Some 200 scientists from all parts of the country are expected to participate in the sessions. The symposium is part of the continuing program of research in nutrition and related fields supported by the National Vitamin Foundation in cooperation with leading university medical schools and medical research centers.

Medical scientists and others interested in the field of nutrition who wish to attend the meeting may obtain further information by addressing the symposium chairman Dr. Frank H. Bethell, Thomas Henry Simpson Memorial Institute for Medical Research, University of Michigan, Ann Arbor, Mich.

■ The 70th annual meeting of the Association of Official Agricultural Chemists will be held 15–17 Oct. at the Shoreham Hotel, Washington, D.C. This meeting, which will be held in cooperation with the Food and Drug Administration, Department of Health, Education, and Welfare, and the Meat Inspection Branch, Department of Agriculture, will commemorate the 50th anniversary of the passage of the Pure Food and Drug Act and the Meat Inspection Act. It will also honor Harvey W. Wiley—the father of the Pure Food and Drug Act.

The meeting will emphasize the application of modern methods of analysis to the enforcement of the nation's laws regulating the composition and labeling of foods, drugs, cosmetics, animal feeds, fertilizers, and pesticides that are purchased and used by the American and Canadian consumer. At a general session R. E. Proctor, head of the food technology department of the Massachusetts Institute of Technology will discuss "Radiation problems of foods and drugs." E. P. Laug of the Food and Drug Administration will present a recently declassified report on his Civil Defense project to determine the effect of nuclear explosions on foods that were exposed during Operation Teapot in the spring of 1955. The application of gas chromatography, a technique less than 5 years old, to food analysis will be described by R. D. Stanley and F. H. Vannier of the U.S. Department of Agriculture, Pasadena, Calif.

The association's annual banquet, to be held on 15 Oct., will honor Dr. Wiley. Fredrick L. Hovde, president of Purdue University, will be the featured speaker at the banquet. Wiley was the first professor of chemistry at Purdue and state chemist of Indiana before he became chief chemist of the Bureau of Chemistry in the Department of Agriculture.

All sessions are open to interested scientific workers and to the public. Copies of the complete program will be available on about 1 Oct. from the secretary, William Horwitz, Box 540, Benjamin Franklin Station, Washington 4, D.C. The AOAC meeting will be followed by meetings of the American Feed Control Officials, Fertilizer Control Officials, and Pesticide Control Officials. These organizations are concerned with the state and federal laws and regulations dealing with these commodities.

■ An International Conference on Scientific Information is to be held in 1958 in Washington, D.C., under the sponsorship of the American Documentation Insti-

tute, the National Academy of Sciences–National Research Council, and the National Science Foundation. The sponsors believe that the mass of research results being published is overtaxing the existing facilities for organizing scientific information. The conference is being arranged to provide an opportunity for a thorough discussion of the status of research on scientific information problems and methods of solving them.

A preliminary planning committee has been established under the chairmanship of Milton O. Lee, Federation of American Societies for Experimental Biology; Alberto Thompson of the National Science Foundation is executive secretary.

According to present plans, approximately 150 foreign and United States experts in all fields involving the organization and dissemination of scientific information will be invited to participate in the conference. In addition to the active participants, arrangements will be made for those with an interest in the problem to attend as observers.

All papers will be printed and distributed in advance so that they need not be read at the conference. Instead, they will be discussed in detail by review panels and the invited participants.

Society Elections

■ Phi Lambda Upsilon (chemistry): pres., James M. Church, Columbia University; v. pres., Carl S. Carlson, Standard Oil Company, New York, N.Y.; sec., Thomas B. Cameron, University of Cincinnati; treas., William G. Schrenk, Kansas State College.

■ American Rheumatism Association: pres., William D. Robinson; 1st v. pres. and pres.-elect, L. Maxwell Lockie; 2nd v. pres., Wallace Graham; sec.-treas., Edward F. Hartung. Representative to the AAAS Council is Russell L. Cecil.

■ Society of Protozoologists: pres., Alfred M. Elliott, University of Michigan; sec., Norman D. Levine, University of Illinois, Urbana; treas., William F. Diller, University of Pennsylvania. The vice presidents are Harold W. Beams, State University of Iowa, and William D. Burbanck, Emory University. Representative to the AAAS Council is R. P. Hall.

■ Tissue Culture Association: pres., Philip R. White, Jackson Memorial Laboratory, Bar Harbor, Me.; v. pres., Joseph F. Morgan, Department of National Health and Welfare, Ottawa, Canada; member-at-large, Morgan Harris, University of California, Berkeley; sec.-treas., Duncan C. Hetherington, Duke University School of Medicine; cor.-sec., Joseph Leighton, University of Pittsburgh School of Medicine; ret. pres., Margaret R. Murray, College of Physicians and Surgeons, New York.

Forthcoming Events

October

25–26. Recent Developments in Electron Devices, Inst. of Radio Engineers, Washington, D.C. (E. W. Herold, RCA Laboratories, Princeton, N.J.)

26–27. Kentucky Academy of Science, annual. Richmond. (Mary E. Wharton, Georgetown College, Georgetown, Ky.)

26–29. American Heart Assoc., annual, scientific sessions, Cincinnati, Ohio. (Medical Director, AHA, 44 E. 23 St., New York 10.)

27. Eastern Psychiatric Research Assoc., New York, N.Y. (T. R. Robie, 676 Park Ave., East Orange, N.J.)

28–1. American Council of Independent Laboratories, 29th meeting, New York, N.Y. (H. M. Dudley, 4302 East-West Highway, Washington 14.)

29–30. American Cancer Soc., scientific session, New York, N.Y. (ACS, Professional Education Section, 521 W. 57 St., New York 19.)

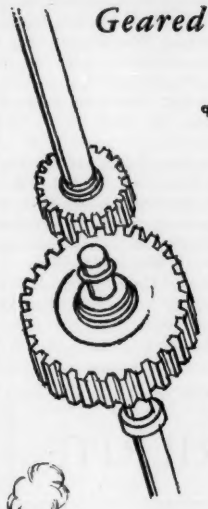
29–30. East Coast Conf. on Aeronautical and Navigational Electronics, 3rd annual, Baltimore, Md. (W. D. Crawford, Westinghouse Electric Corp., Air Arm Div., Friendship International Airport, Baltimore 27.)

29–31. Energy Resources Conf., Denver, Colo. (Energy Resources Conf., c/o Denver Chamber of Commerce, 1301 Welton St., Denver 4.)

29–1. Conference on Climatology sponsored by American Meteorological Soc., Asheville, N.C. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

29–1. Society of Exploration Geophysicists, annual, New Orleans, La. (G. A. Grimm, Tide Water Associated Oil Co., Box 2131, Midland, Tex.)

Geared to your needs . . .



For immediate delivery of quality biochemicals at economical prices, NUTRITIONAL BIOCHEMICALS CORPORATION is geared to serve you.

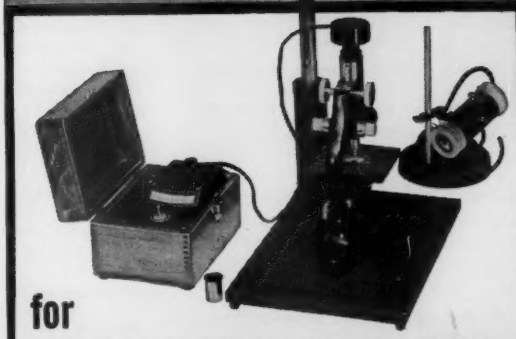
- AMINO ACIDS: PEPTIDES
- "VITAMIN FREE" CASEIN HYDROLYSATE
- NUCLEOPROTEINS PURINES, PYRIMIDINES
- MISCELLANEOUS BIOCHEMICALS
- VITAMINS
- ENZYMES
- GROWTH FACTORS
- STEROID HORMONES
- BIOLOGICAL SALT MIXTURES
- BIOLOGICAL TEST MATERIALS

NUTRITIONAL BIOCHEMICALS CORPORATION

21010 Miles Avenue . . . Cleveland 28, Ohio

Write For New Catalog August 1956 Over 1700 Items Write Dept. 102

PHOTOVOLT EXPOSURE PHOTOMETER Mod. 200-M



for PHOTOMICROGRAPHY

Accurate determination of exposure time in black-and-white and color photomicrography

Write for Bulletin #810 to **Price $92.00**

PHOTOVOLT CORP.

95 Madison Ave. New York 16, N. Y.

KLETT ELECTROPHORESIS

CUSTOM MADE

TOOL FOR THE ANALYSIS OF COMPLEX COLLOID SYSTEMS, AND FOR THE CONTROL OF PRODUCTION OF PURIFIED PROTEINS, ENZYMES, HORMONES

KLETT MANUFACTURING CO.
179 EAST 87TH STREET
NEW YORK, N. Y.

ADVANCES IN EXPERIMENTAL CARIES RESEARCH

AAAS SYMPOSIUM VOLUME

June 1955

246 pp., 6" x 9", 49 illus., index, clothbound

Price $6.75; cash order price for AAAS members $5.75

". . . This is a real contribution to dental science. It is the most comprehensive review of animal experimentation on caries ever attempted. The format and reproduction of illustrations are excellent.

"This compilation of research findings should have wide circulation and should be a storehouse of information for all those who are investigating the problem of dental caries. It should serve to clarify the thinking and prevent useless duplication in future studies. . . ."

Russell W. Bunting, School of Dentistry, University of Michigan.

AAAS, 1515 Mass. Ave., NW, Washington 5, D.C.

Get this FREE Catalog on UNITRON Microscopes!

Here's a typical UNITRON value

PHASE CONTRAST, MPE

Indispensable for the study of living cells and other highly transparent material without staining. Continuous transition from phase to bright-field microscopy by adjusting condenser height. Choice of 4 contrasts. Mechanical stage. Three phase objectives: P10X, P40X, P100X. Eyepieces: 5X, 10X, P15X.

only $265.

A complete line of Microscopes...

- Metallurgical • Phase
- Laboratory • Polarizing
- Stereoscopic • Student

Used in leading universities, industrial and government laboratories.

FREE 10-DAY TRIAL

Let these instruments prove their value to you, in your own laboratory, before you purchase.

United Scientific Co.

204-6 MILK STREET • BOSTON 9, MASS.

Please rush to me, free of charge, your complete catalog on UNITRON Microscopes.

Name.....

Title.....

Company.....

Address.....

City.....State.....

29–2. Convention on Ferrites, Institution of Electrical Engineers, London, England. (Secretary, IEE, Savoy Place, London, W. C.2.)

31. Society of Vertebrate Paleontology, Minneapolis, Minn. (J. T. Gregory, SVP, Peabody Museum of Natural History, Yale Univ., New Haven, Conn.)

31–1. Western Area Development Conf., 3rd, Phoenix, Ariz. (C. Green, Mountain States Office, Stanford Research Inst., Phoenix.)

31–2. Geological Soc. of America, annual, Minneapolis, Minn. (H. R. Aldrich, GSA, 419 W. 117 St., New York 27.)

31–2. Mineralogical Soc. of America, Minneapolis, Minn. (C. S. Hurlbut, Jr., 12 Geological Museum, Oxford St., Cambridge 38, Mass.)

31–2. Soc. of Economic Geologists, annual, Minneapolis, Minn. (O. N. Rove, 30 E. 42 St., New York 17.)

31–2. Society for Experimental Stress Analysis, annual, Columbus, Ohio (W. M. Murray, Massachusetts Inst. of Technology, Cambridge 39.)

31–3. American Soc. of Tropical Medicine and Hygiene, New Orleans, La. (J. E. Larsh, Jr., School of Public Health, Univ. of North Carolina, Chapel Hill.)

31–3. Gaseous Electronics Conf., 9th annual, Pittsburgh, Pa. (A. V. Phelps, Westinghouse Research Laboratories, Beulah Rd., Pittsburgh 35.)

November

1–2. Society for Applied Spectroscopy, 11th annual, New York, N.Y. (F. M. Biffen, Johns-Manville Research Center, Manville, N.J.)

1–3. Association of Geology Teachers, annual, Chicago, Ill. (C. E. Prouty, Dept. of Geology, Univ. of Pittsburgh, Pittsburgh 13, Pa.)

5–7. Paleontological Soc., annual, Minneapolis, Minn. (H. B. Whittington, Museum of Comparative Zoology, Harvard Univ., Cambridge, Mass.)

6–15. International Grassland Cong., 7th, Palmerston, New Zealand. (S. H. Saxby, P.O. Box 2298, Wellington, New Zealand.)

7–9. Electrical Techniques in Medicine and Biology, 9th annual conf., New York, N.Y. (E. D. Trout, X-Ray Dept., General Electric Co., Milwaukee 1, Wis.)

7–9. Society of Rheology, annual, Pittsburgh, Pa. (W. R. Willets, Titanium Pigment Corp., 99 Hudson St., New York 13.)

8–9. Canadian High Polymer Forum, 7th, Sarnia, Ont. (M. H. Jones, Ontario Research Foundation, 43 Queen's Park, Toronto 5, Ont.)

8–10. Gerontological Soc., annual, Chicago, Ill. (N. W. Shock, Baltimore City Hospitals, Baltimore 24, Md.)

10. Society for the Scientific Study of Religion, fall meeting, Cambridge, Mass. (R. W. Burhoe, American Acad. of Arts and Sciences, Cambridge 36.)

11–12. American Soc. for the Study of Arteriosclerosis, annual, Chicago, Ill. (R. G. Gould, P.O. Box 1663, Los Alamos, N.M.)

11–17. Cardiology, 5th Inter-American cong. of, Havana, Cuba. (I. Chavez, Calzada de la Piedad 300, Mexico, D.F., Mexico.)

12–14. Association of Military Surgeons of the U.S., annual, Washington, D.C. (S. E. Womeldorph, AMSUS, Suite 718, 1726 Eye St., NW, Washington 6.)

12–15. American Petroleum Inst., 36th annual, Chicago, Ill. (API, 50 W. 50 St., New York 20.)

12–16. American Public Health Assoc., 84th annual, Atlantic City, N.J. (R. M. Atwater, 1790 Broadway, New York 19.)

12–16. American Soc. of Agronomy, annual, Cincinnati, Ohio. (L. G. Monthey, 2702 Monroe St., Madison 5, Wis.)

13–15. Historical Development of Physiological Thought, symposium, Brooklyn,

SOLIDS·LIQUIDS·GASES·SOLIDS·LIQUIDS·GASES·SOLIDS·LIQUIDS·GASES·SOLIDS·LIQUIDS·GASES·SOLIDS·LIQUIDS·GASES·SOLIDS·LIQUIDS·GASES·SOLIDS

DRIERITE

"THE VERSATILE DESICCANT"

For All Drying Operations

of

Institution-Industry

Laboratory-Plant

Efficient — Dries all organic liquids instantly in liquid or vapor phase. Gases retain only 0.005 mg. H_2O per liter.

Versatile — An all-purpose desiccant.

Non-Wetting — Does not become wet on saturation, nor crystallize to walls of tubes, towers, or desiccators.

Neutral — Dries without reacting with either acid or alkaline materials.

Inert — Except toward water. Does not decompose, polymerize, or catalyze organic substances by contact. Insoluble in organic liquids.

Regenerative — Repeatedly after any normal use, by dehydration at 200 to 225°C.

Economical — Lowest priced high grade desiccant. Available in quantity for industrial processes.

REFERENCES

(1) Ind. & Eng. Chem. 25-653 (June, 1933)
(2) Ind. & Eng. Chem. 25-1112 (Oct., 1933)
(3) National Bureau of Standards Journal of Research 12-241 (Feb., 1934, R. P. No. 649)

Granule Sizes: 2, 4, 6, 8, 10-20, and minus 20 mesh.

Write for literature and quotations

W. A. Hammond Drierite Co.

120 Dayton Avenue

XENIA, OHIO

N.Y. (E. Goodwin, State Univ. of New York, College of Medicine, Brooklyn 3.)

14–15. Industrial Hygiene Foundation, 21st annual, Pittsburgh, Pa. (C. R. Walmer, IHF, Mellon Inst., Pittsburgh.)

14–16. Optics and Microwaves, symp., Washington, D.C. (Symp. on Optics and Microwaves, P.O. Box 355, Falls Church, Va.)

14–16. Newer Developments in the Diagnosis and Management of Cancer, symp., Duarte, Calif. (J. Love, Director, Div. of Postgraduate Medical Education, City of Hope Medical Center, Duarte.)

15–16. American Philosophical Soc., Philadelphia, Pa. (APA, 104 S. 5 St., Philadelphia 6.)

15–16. Operations Research Soc. of America, 10th natl., San Francisco, Calif. (T. E. Oberbeck, U.S. Naval Post Graduate School, Monterey, Calif.)

15–16. Society of Technical Writers, jointly with Assoc. of Technical Writers and Editors, New York, N.Y. (S. F. Shapiro, STW, P.O. Box 22, Newton Centre 59, Mass.)

15–17. Acoustical Soc. of America, Los Angeles, Calif. (W. Waterfall, ASA, 57 E. 55 St., New York 22.)

18–25. National Meeting of Surgeons, Mexico City, Mexico. (Intern. Acad. of Proctology, 147–41 Sanford Ave., Flushing, N.Y.)

19–20. Entomological Soc. of America, Eastern Branch, Atlantic City, N.J. (B. F. Driggers, Experiment Station, New Brunswick, N.J.)

22–23. Calder Hall Nuclear Power Station, conf., London, England. (Secretary, British Nuclear Energy Conference, 1–7 Great George St., London, S.W.1.)

22–3. International Cong. of Industrial Chemistry, 29th, Paris, France. (J. Gerard, Société de Chimie Industrielle, 28, rue Saint-Dominique, Paris VII^{e}.)

23–24. American Mathematical Soc., Evanston, Ill. (E. G. Begle, 207 Leet Oliver Memorial Hall, Yale Univ., New Haven 11, Conn.)

23–24. American Physical Soc., Chicago, Ill. (K. K. Darrow, APS, Columbia Univ., N.Y. 27.)

23–24. American Soc. of Animal Production, annual, Chicago, Ill. (W. M. Beeson, Dept. of Animal Husbandry, Purdue Univ., W. Lafayette, Ind.)

24. American Ethnological Soc., New York, N.Y. (A. G. James, Hunter College, Bronx 68, N.Y.)

25–30. American Rocket Soc., annual, New York, N.Y. (J. J. Harford, ARS, 29 W. 39 St., New York 18.)

25–30. American Soc. of Mechanical Engineers, annual, New York, N.Y. (C. E. Davies, ASME, 29 W. 39 St., New York 18.)

26–28. American Soc. of Refrigerating Engineers, Boston, Mass. (R. C. Cross, ASRE, 234 Fifth Ave., New York 1.)

26–30. Automation Exposition, 3rd intern., New York, N.Y. (TIAE, Richard Rimbach Associates, Inc., 845-A Ridge Ave., Pittsburgh 12, Pa.)

27–30. American Medical Assoc., clinical, Seattle, Wash. (G. F. Lull, AMA, 535 N. Dearborn St., Chicago 10, Ill.)

27–30. National Chemical Exposition, 9th, Cleveland, Ohio. (American Chemical Soc., 1155 16 St., NW, Washington 6.)

(See issue of 21 September for comprehensive list)

(above) Nuclear-Chicago scintillation detector is lowered into water for tracing the radioactive sewage effluent at varied depths over a 25 square mile area. (right) Gamma-ray spectrometer system, ratemeter and recorder on laboratory ship measure and chart traces of radioactive scandium during 36-hour period of experiment.

RADIOACTIVITY HELPS PREVENT BEACH POLLUTION FROM SEWAGE EFFLUENT

In a unique experiment just completed in Santa Monica Bay, California, radioactive isotopes were successfully used to trace the dispersion of sewage effluent in ocean waters. The results are helping to establish proper design procedures to insure against beach pollution in a current expansion of the Los Angeles sewage system.

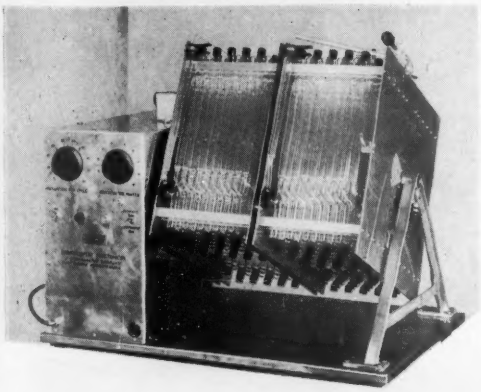
The tracer experiment was a joint project of Hyperion Engineers, Nuclear Science and Engineering Corporation and the Hancock Foundation of the University of Southern California. Twenty curies of scandium-46 were mixed with sewage effluent and discharged into the sea. Scientists aboard a laboratory ship then took radioactive measurements over a wide area to determine dilution rate and direction of diffusion.

Since this was a "one-shot" experiment, the dependability and overall sensitivity of the equipment were extremely important. The instruments chosen, including the DS5-3 scintillation detector, 1810 gamma-ray spectrometer, 181 scaler and 1620 ratemeter were standard Nuclear-Chicago catalog items.

nuclear-chicago

NUCLEAR INSTRUMENT AND CHEMICAL CORPORATION
237 West Erie Street, Chicago 10, Illinois
LEADERS IN MAKING RADIOACTIVITY COUNT

COUNTERCURRENT EXTRACTOR



For separation and analysis of mixtures

Send for complete laboratory manual

E-C APPARATUS COMPANY
538 WALNUT LANE, SWARTHMORE, PENNA.

POPULATION GENETICS:

The Nature and Causes of Genetic Variability

Cold Spring Harbor Symposia on Quantitative Biology *Volume XX (1955), 350 + xiii quarto pages, with numerous figures*

Authoritative reviews of research dealing with various problems of population genetics presented in 32 papers and edited discussions. Problems considered are: theory of population genetics, theory of quantitative genetics, selection in plants and animals, genetic variability and polymorphism, populations in time and space, and integration of genotypes.

Previous volumes still available: IX (1941) Genes and Chromosomes; XIII (1948) Biological Applications of Tracer Elements; XIV (1949) Amino Acids and Proteins; XV (1950) Origin and Evolution of Man; XVI (1951) Genes and Mutations; XVII (1952) The Neuron; XVIII (1953) Viruses; XIX (1954) The Mammalian Fetus.

Prices: Volumes IX–XV, $7; XVI–XX, $8. Volumes IX, XV, XVI, XVIII and XX: any two, $14; any three, $19; any four, $24; all five, $29.

Address: Biological Laboratory, Cold Spring Harbor, N. Y.

PERSONNEL PLACEMENT

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

COPY for classified ads must reach SCIENCE 2 weeks before date of issue (Friday of every week).

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	**$22.00 per inch**
13 times in 1 year	**21.00 per inch**
26 times in 1 year	**20.00 per inch**
52 times in 1 year	**19.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

POSITIONS OPEN

Pharmacologists—Ph.D.

Established Research Division of growing Pharmaceutical Company has immediate opportunities for pharmacologists with experience and training in:

1) CNS drug research. Work will involve general pharmacological screening and development of pharmacological testing methods.
2) Cardiovascular research. Work will involve design and supervision of screening procedures and development of basic research program.

Company has modern research facilities, complete employee benefit program and is located in rural area of central New York State. Forward résumés to Personnel Director, The Norwich Pharmacal Company, Norwich, New York.

POSITIONS OPEN

PH.D. — VIROLOGIST

Position available in well-established, expanding midwestern pharmaceutical company. Candidate selected will head established tissue culture laboratory.

Applicants preferably should have training in virology with special emphasis on tissue culture techniques. Salary open, dependent on experience. Our employees know of this advertisement. Please send résumé to Box 222, SCIENCE.

Psychology Assistant; B.S. or M.S. in psychology, but will consider a person with a general background in biology and, if possible, some training in psychology. Must be stable, patient person willing to handle animals in psychological and physiological experiments. Male preferred, but will consider a woman if qualified. Frontrank ethical pharmaceutical house located Midwest. Apply Box 224, SCIENCE. 10/5

Scientific Writer. Young M.D. or person with equivalent training in medical science with literary interest and talent to write technical material for the medical profession. Work involves interpretation of laboratory and clinical data on new drugs explaining composition, application, use, therapeutic action of new drug discoveries for F.D.A., scientific publications, and practising physicians. Large midwestern ethical pharmaceutical research and manufacturing organization. Please send complete résumé to Box 213, SCIENCE. 9/7, 14, 21

POSITIONS OPEN

(a) Physician qualified in one of biological sciences or with graduate training in a specialty; department clinical research, major pharmaceutical company; career position; $14,000. **(b) Chemist;** Ph.D., to direct clinical laboratories, 350-bed general hospital affiliated medical school; knowledge of advanced chemistry desirable; $7000 to $10,000; Midwest. **(c) Toxicologist;** although Ph.D. in pharmacology preferred, one with doctorate in biochemistry acceptable; industrial toxicology laboratory, large company; experience in industrial toxicology advantageous; $10,000. **(d) Scientists** with research administration backgrounds; experience in research involving research on therapy, etiology, pathogenesis of cancer desired. S9-28 Medical Bureau (Burneice Larson, Director), 900 North Michigan Avenue, Chicago. X

Radiology. Opening for a responsible individual as assistant in radiology for work in isotope laboratory. Academic appointment; research opportunity; minimum salary $5500. Minimum requirements, B.S. in physics. Some experience desired. Submit replies to Dr. Walter S. Moos, Department of Radiology, University of Illinois, 840 S. Wood Street, Chicago 12, Illinois. 10/5, 12

POSITIONS WANTED

Bacteriologist well qualified in immunology and microbiology; Ph.D.; 6 years' research microbiologist, well-known institution. Medical Bureau (Burneice Larson, Director), 900 North Michigan Avenue, Chicago. X

Virologist, Ph.D. Creative competent investigator. Research background with phages and animal viruses. Desires responsible position in research. Industrial or academic. Box 226, SCIENCE. 10/5

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	**$22.00 per inch**
13 times in 1 year	**21.00 per inch**
26 times in 1 year	**20.00 per inch**
52 times in 1 year	**19.00 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . . **SCIENTIFIC PERIODICALS and BOOKS**

Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted.

WALTER J. JOHNSON, INC.
125 E. 23rd St., New York 10, N. Y.

SCIENTIFIC JOURNALS WANTED

Sets, Runs and Volumes bought at top prices. Your wants supplied from our Back Files of over 3,000,000 periodicals.
Abrahams Magazine Service; N. Y. 3, N. Y.

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, Inc. Boston 19, Massachusetts

PROFESSIONAL SERVICES

WISCONSIN ALUMNI RESEARCH FOUNDATION

Project Consultation and Production Control Services in Biochemistry, Chemistry, Bacteriology, Toxicology — Insecticide Testing — Flavor Evaluation.

WRITE FOR PRICE SCHEDULE
WISCONSIN ALUMNI RESEARCH FOUNDATION
P. O. BOX 2217-V • MADISON 1, WISCONSIN

TO AUTHORS
seeking a publisher

Learn how we can publish, promote and distribute your book on a professional, dignified basis. All subjects considered. Scholarly and scientific works a specialty. Many successes, one a best seller. Write for booklet SC—it's free.

VANTAGE PRESS, Inc. • 120 W. 31 St., N.Y. 1
In Calif.: 6253 Hollywood Blvd., Hollywood 28
In Wash., D.C.: 1010 Vermont Ave., NW

"OUR PREVIOUS AD

created a great deal of interest, for which we are grateful. Additional advertising in your magazine is contemplated."

PROFESSIONAL SERVICES

LaWall & Harrisson
Div. S, 1921 Walnut St., Philadelphia 3, Pa.
SINCE 1870
Food & Drug PROBLEMS
Pharmacological BACTERIOLOGICAL CHEMICAL

SUPPLIES AND EQUIPMENT

albino rats *
Hypophysectomized Rats
*Descendants of the Sprague-Dawley and Wistar Strains

"From the hand of the veterinarian to research"

HENRY L. FOSTER, D.V.M.
President and Director
THE CHARLES RIVER BREEDING LABS.
Dept. B, Wilmington, Mass.

GME
714 MARKET PLACE
MADISON 3, WIS.

SEND FOR DETAILS ON THE NEW, ULTRA-COMPACT GME-LARDY WARBURG APPARATUS

ALBINO RATS

Our mass production methods insure greatest uniformity and consistency
Price list on request

DAN ROLFSMEYER CO. ■ Ph. 6-6149
Route 3, Syene Road, Madison, Wisconsin

Special LaMOTTE Reagents for Analysis

TIRON—for determination of Iron, Titanium, and Molybdenum

ZINCON—for determination of Zinc and Copper

★★★★

Send for LaMotte Catalog on CHEMICAL CONTROLS for **pH, Chlorine, Phosphates and Polyphosphates, etc.**

LaMotte Chemical Prod. Co.
Dept. H Chestertown, Md.

WHITE MICE

We specialize in White Mice (Swiss) Only
Information sent on request

STOKELY-PETERSON, INC.
P.O. Box 1254, Madison 1, Wis. PH. ALpine 5-1303

SUPPLIES AND EQUIPMENT

SPRAGUE-DAWLEY, INC.

PIONEERS IN THE DEVELOPMENT OF THE STANDARD LABORATORY RAT

OUR PLEDGE: Our insistence on the highest possible quality will never be sacrificed to quantity.

Sprague-Dawley, Inc.
P.O. Box 2071
Madison 5, Wisconsin
Phone: CEdar 3-5318

High quality lantern slides, charts and graphs, photomicrography, general photography and scientific and medical artwork

FOR DETAILS AND PRICE LIST WRITE:
MEDICAL PHOTOGRAPHY AND ART SERVICE
5354 Dixie Highway, Louisville, Kentucky

CONSISTENT RATS & MICE

BUDD MT. RODENT FARM
CHESTER, N. J.

Breeders of a recognized strain of Wistar rats and W.S. mice

STAINS—GURR'S—INDICATORS
FREE PRICE LIST
ESBE LABORATORY SUPPLIES
459 Bloor St., W. Toronto, Canada

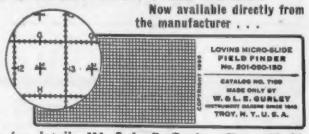
HOLTZMAN COMPANY

The exceptional docility of our rats is evidenced first in the ease in which they can be handled. Most important though is the group uniformity of this characteristic. Thus, because of their docility, our rats can often be used to better advantage in research in which growth or internal organic changes are factors under observation.

Rte 4, Box 205 Madison, Wisc. Phone ALpine 6-5573

SWISS MICE
TACONIC FARMS
GERMANTOWN, NEW YORK — Phone 3535

LOVINS MICRO-SLIDE FIELD FINDER
Now available directly from the manufacturer . . .

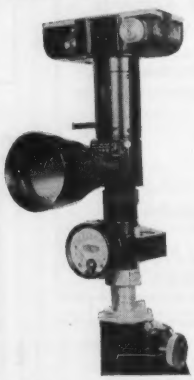


Write for details. W. & L. E. Gurley, Troy, N. Y.

Research Service
NON AQUEOUS
ELECTRICAL CONDUCTIVITY
PRECISION MEASUREMENTS
APPLIED SCIENCE LABORATORIES, INC.
140 N. Barnard St., State College, Pa. • AD 8-6282

romicron
EXPOSURE METER
FOR
PHOTOMICROGRAPHY

- self contained, no external wires
- instantaneous readings
- removal from microscope unnecessary
- adaptable to any standard microscope
- readings are easily taken by moving a lever



Ideal for:
Bellows Cameras
Attachment Cameras
Beamsplitters and
Motion Picture Units

Write for pamphlet S-30

PAUL ROSENTHAL
505 Fifth Avenue New York 17, N. Y.
Microscopes & Scientific Apparatus

SCIENCE-1955 ON MICROCARDS

The response to the Microcard edition has encouraged us to make volumes 121 and 122 of SCIENCE available in this form.

Seventy-seven 3" x 5" cards contain 2337 pages of SCIENCE for the year 1955.

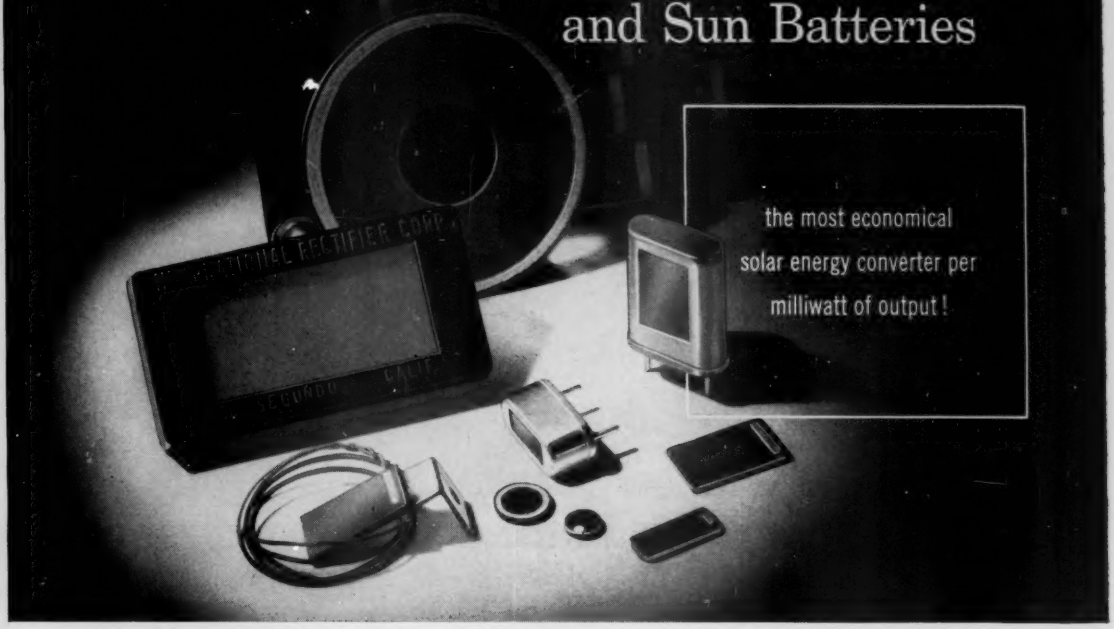
The space saving is considerable—25 sets of Microcards take up approximately the same space as a single bound volume of SCIENCE covering the same period. The bother and expense of binding are completely eliminated. In spite of the increase in format, the price remains unchanged:

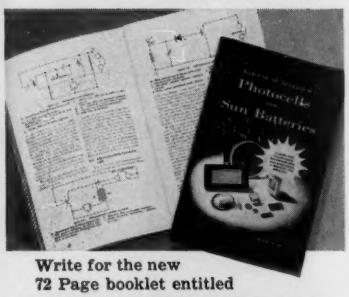
Microcard edition of SCIENCE, 1953 $15.00
" " of SCIENCE, 1954 $15.00
" " of SCIENCE, 1955 $15.00
First half of 1956 only ..... $ 7.50

AAAS
1515 Mass. Ave., NW
Washington 5, D.C.

International

Selenium Photo-Cells and Sun Batteries





Write for the new
72 Page booklet entitled

"The Use of Selenium Photocells and Sun Batteries"

This handbook, of interest to scientists, engineers and experimenters, contains the basic theory and typical applications of photovoltaic cells. Copies are available for $1.50 from our Product Information Dept.

For over 8 years, International Rectifier Corporation has been a recognized leader in the development and production of high quality selenium photoelectric cells for industrial applications. Drawing from 15 years experience in this field, International's research engineers have pioneered many of the recent advancements in the field devoted to the conversion of solar energy to electrical power. The resulting selenium sun batteries now available provide performance equal to any type of solar energy converter commercially available to industry today, *at a cost up to 50% below that of units utilizing other generating materials!*

International Rectifier Photo-Cells and Sun Batteries are available in a wide variety of sizes, mounted or unmounted. Hermetically sealed units can be supplied to operate submerged in liquids or for outdoor applications where protection from corrosion is required. When applied and mounted properly, International's photovoltaic cells provide virtually unlimited life expectancy, evidence no irreversible fatigue or aging.

Whatever your application, from light measurement and control devices of all types to supplying power for transistorized equipment, you will find the most economical unit to specify is an International Photovoltaic cell.

For complete technical data on incident illumination intensity ranges, spectral response, ambient temperature range, etc., write on your letterhead to the Product Information Department for bulletins on all types of photocells available.

A WORLD OF DIFFERENCE ...THROUGH RESEARCH

International Rectifier

CORPORATION

EXECUTIVE OFFICES: EL SEGUNDO, CALIFORNIA · PHONE OREGON 8-6281

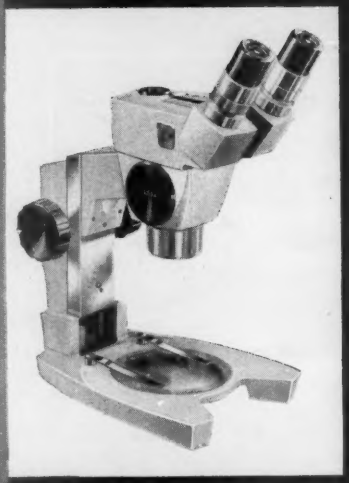
NEW YORK: 132 E. 70TH ST., TRAFALGAR 9-3330 · CHICAGO: 205 W. WACKER DR., FRANKLIN 2-3899
IN CANADA: ATLAS RADIO CORP., LTD., 50 WINGOLD AVE. W., TORONTO, ONTARIO, RU 1-6174

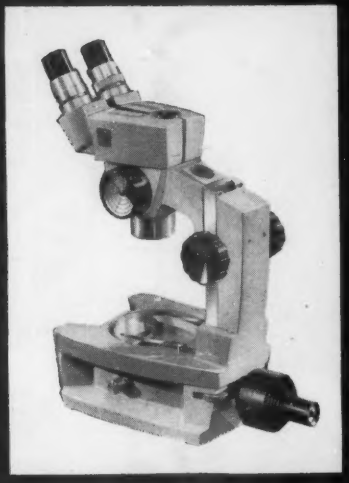
THE WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS

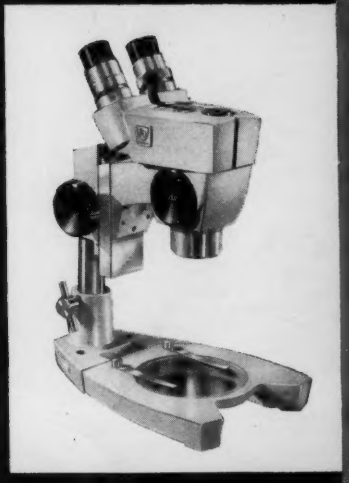
SPENCER

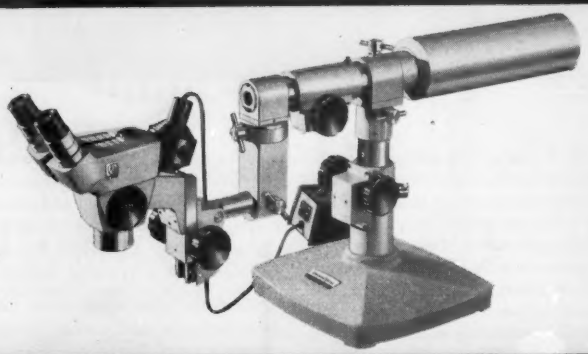
CYCLOPTIC

completely new series of STEREOSCOPIC MICROSCOPES









MAGNI-CHANGER

Desired magnifications simply "dialed-in" by rotation of calibrated cylinder.

Outstanding Features

- *True three dimensional image*
- *Long working distance*
- *Reversible, inclined body*
- *Large field of view*
- *Durable EPOXY finish*
- *Top quality optics*
- *Broad selection of models*
- *LOW PRICE*

Why not make this the week for you to discover that the new CYCLOPTIC Series offers you the exact model to meet your very need.

Get the whole AO CYCLOPTIC story . . . request literature today.

American Optical

Instrument Division, Buffalo, N. Y.
Defense Products Plant, Keene, N. H.

NEW BROCHURE JUST OFF THE PRESS . . . WRITE FOR YOUR COPY

Dept. I-4

Gentlemen:

Rush new CYCLOPTIC brochure, SB56

Name_____

Address_____

City_____ Zone____ State_____